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For the American Repertory.

FORCE EXERTED BY WATER IN FREEZING—ITS APPLICATION IN SPLITTING ROCKS.

The expansive property of water in freezing gives to ice in masses a less specific gravity than water, and thus enables it to swim; and although this may at first seem a paradox, it is nevertheless strictly in accordance with the laws of nature. It is well known that cold contracts all bodies into a smaller compass, and consequently increases their specific gravity. Now when water reaches the freezing point it crystalizes, and though each particle or primary crystal must be heavier than its bulk of water, a combination of the particles in a mass of ice is specifically lighter than the same bulk of water, and it therefore swims on the surface. A remarkable instance of the expansive power of water during the progress of congelation was afforded a few years since at Cincinnati. A large anvil, weighing upwards of three tons, was left lying near the door of the iron foundry of Harkness, Vorhees & Co. and exposed to the weather. It was perfectly solid and sound, with the exception of a very narrow fissure in the centre of one side, about five inches in length, and reaching in to near the same depth. This crevice became filled with water, which was afterwards frozen, and its expansive force during the process completely severed this huge mass of

iron into two parts. A more striking instance of the tremendous force thus exerted by water has perhaps rarely been recorded.

A number of experiments which I tried during the winter of 1839, '40, with a view of applying this power in a practical way, promise extended benefits. These experiments were made in splitting logs, and although most of the logs operated upon were impermeable to axe or wedge, yet in every instance they yielded to the force exerted by the water during the process of congelation. In order to make the experiment succeed completely, the log which it was proposed to operate upon had several holes bored in it; these holes were in a line with each other, and never exceeded in depth two-thirds of the diameter of the log. At the time of the experiment, which was during very cold weather, the holes were filled with water previously boiled and cooled.

Reasoning *à priori* from the foregoing circumstances, I conclude that the expansive force of water in freezing may be rendered of the highest practical utility in splitting rocks.

Water under the circumstances here considered commences freezing at the top, and consequently it freezes downward: accordingly as soon as the top is congealed, the expansive force of the water begins to act. Now conceiving one of the holes to be a cylinder, it is quite evident that the effective power, in other words, the force, exerted directly in separating the log, bears the same proportion to the waste power or force exerted upwards against the ice, and downwards against the log, that the curve superfices of the cylinder bears to the surfaces of the ends; consequently, putting $a=$ depth of the hole, $d=$ diameter, $y=$ effective power, and $z=$ waste power, we have the analogy $y : z :: (ad)\ 3{\cdot}1415926 : d^2 \times {\cdot}7854 \times 2$, observing to make the product of the means and extremes equal, we obtain the equation $(zad) \times 3{\cdot}1415926) = (2y)\, d^2 \times {\cdot}7854$; consequently if ad and y were given, z would be determinate from the equation $\frac{2y \times {\cdot}7854\,(d^2)}{ad \times 3{\cdot}1415926} = z$; also if ad and z were given, y would be determinate from $\frac{zad \times {\cdot}31415926}{d^2 \times {\cdot}7854 \times 2} = y$.

P.

[For the American Repertory.]

METALLURGICAL NOTICES.

BY DR. LEWIS FEUCHTWANGER.

II. *On Gilding.*

This metallurgical operation consists in covering various metals and other substances with a thin layer of gold, for the purpose of imitating color, or lustre, or for protecting certain metals from oxidation. Wood, pasteboard, leather, plaster of paris, paper, cotton, linen, or silk goods, ivory, silver, brass, bronze, copper, tin, iron, and other metals, may all be coated in different ways by means of gold in substance or in solution; and likewise by a pseudo-gilding process, such as varnishing and coloring. These latter operations are either used for brass instruments, in order to give them the appearance of gold and make them more saleable, or the coloring is employed for jewelry, which contains but a small portion of gold—the gilding preparation containing mordants, ingredients which dissolve on the surface all the baser metal, and make the small portion of gold only visible.

1. The varnish gilding is performed by a varnish prepared in the following manner:—Digest for several days in warm temperature,

1 ounce gum gamboge,
20 grains dragon's blood,
20 " saffron, with
20 ounces spirit of wine,

and when sufficiently colored, to be filtered, and the varnish to be applied by means of a sponge on the instrument, which has been previously warmed, and when cold, a fine gold color is visible. The articles when soiled may be washed in cold water without injuring the varnish. Another false gilding is performed by

2. Preparing an amalgam of 1 part of zinc and 12 parts of quicksilver, dissolving the same in muriatic acid; the mixture may be boiled with these copper articles which have been previously cleaned by diluted nitric acid.

The coloring of jewelry is performed,

1. By suspending the ware in a boiling mixture of pure muriatic acid, alum, and saltpetre, or by

2. Making a neutral solution of

Chloride of gold,	- - -	20 grains
Muriatic acid,	- -	10 parts
Oil vitriol,	- - -	4 "
Boracic acid,	- -	2 "
Water,	- - - -	150 "

Keep the solution boiling, and suspend within it cleaned articles of jewelry hung upon a gold wire.

After a few minutes throw in the same vessel a copper wire, which must necessarily touch the jewelry, and be left in contact until the articles have assumed a dark color; then withdraw the wire again, and leave the articles in the liquid until they have the desired color; remove and immerse them in lukewarm water, acidulated by either sulphuric or acetic acid, and wash them out in warm water and dry them over a coal fire, and repeat the same operation two or three times.

The *oil gilding* is mostly used on paper, pasteboard, leather, wood, laquered ware, statues, &c, and requires much mechanical skill to do it well; the operation consists,

1. In letting the articles be well dried, so that not the least moisture adheres, and passing quickly the first composition, which consists of the gold color (to be had at any paint-shop, and being nothing but the remnants of paints) and boiled linseed oil in equal proportions, so as to have a perfect uniform coat, or by making a varnish of 2 parts wax to 1 part mastic varnish made from boiled linseed oil.

2. Applying another varnish prepared from 1 part amber varnish to 2 parts of poppy or other fat oil, likewise quite uniform.

3. Applying the gold leaf, which has been cut in such fragments as required for covering all the parts to be gilt, and use velvet or leather to press over the gilt parts every particle of gold on the varnished spots; dry it in middling temperature, and when perfectly dry give another coat of oil varnish, which will secure it forever, and which allows washing when soiled by fly or other dirt.

The fire and cold gildings are both operations which are

most generally used for covering silver, brass, copper, composition and other metals. Many compositions are more or less apt to be gilt according to their hardness or component parts: such, for instance, as the composition consisting of 85 parts copper, 18 parts zinc, and 3 parts lead, which will assume a better color from gilding than pure silver. The operation of fire gilding divides itself in 10 parts.

1. The boiling or heating and washing with diluted acid.
2. Scrubbing by the brush.
3. The amalgamating liquid.
4. The amalgamation.
5. The laying on of the gold.
6. The evaporation.
7. The washing.
8. The brushing.
9. The clearing.
10. The polishing.

The boiling is performed by putting the metal to be gilt in a clean copper kettle, in which a liquid consisting of red tartar, salt and water is already boiling; then throw the metal to be gilt so that it may be totally covered, and keep it boiling for a quarter of an hour, stirring it with a brass rod. In this way it is cleaned, and afterward assisted by some polishing powder and clean linen rag. After being washed and dried again over coal fire, scrub it by means of a brass brush; if not yet quite clean immerge it into dipping acids, or diluted sulphuric or muriatic acid; but it has to be *heated first* over charcoal fire at a uniform heat until it becomes cherry-red. The *amalgamating* liquor is then applied, which is first prepared by half an ounce of quicksilver, one ounce nitric acid, and nine ounces water, which is rubbed over the cleaned and heated metal. The *amalgam*, consisting of one dram fine gold to one ounce quicksilver, is prepared by putting both in a heated crucible and stirring them well together, and throwing them when well united in an earthen unglazed dish filled with water; which is then applied with a brush over the warmed metal, so as to pass an uniform quantity of the amalgam over the metal, and if necessary, the brush may be dipped in the amalgamating

liquors, and again using the amalgam; when well covered, wash the metal in clean water and dry it off, and then commence the *evaporation* over a slow coal fire, and all quicksilver is driven off when the metal has assumed a good yellow color, and when a drop of water, if thrown upon it, produces a noise; and if found necessary, the amalgamating may be repeated on such places where the gold is not uniformly spread, and the evaporation repeated. The metal is now washed and cleaned by a brush dipped in water and vinegar, and afterward in clean water and dried in saw-dust.

[For the American Repertory.]

OBSERVATIONS ON THE STORM OF DEC. 15, 1839.

BY WILLIAM C. REDFIELD, A. M.*

In the table and map which are annexed to these remarks will be found the observations which have been obtained of the direction of wind in this storm, in the states of Connecticut, Rhode Island, Massachusetts, New-Jersey, and parts of the states of Maine, New-Hampshire, Vermont, and New-York.

The arrows on the map denote, approximately, the direction of wind, at or near the hour of noon, at the several places of observation. The concentric lines, drawn at intervals of thirty miles, were added, not as precisely indicating the true course of the wind, but to afford better means of comparison for the several observations.

It will be seen, that of forty-eight distinct sets of observations, which are comprised in the annexed schedule, about thirty are derived from the meteorological journals of scientific and intelligent observers, or from the log-books of vessels exposed to the storm; and I take this occasion to offer my thanks to the gentlemen who have so kindly furnished me with their observations.

The position assumed for the axis of the gale, at noon, should, perhaps, be nearly in line with the position of the ship Morrison and Cape Cod Bay; at which places the wind was then blowing from opposite points of the compass, but, as may be seen,

* Read before the American Philosophical Society, Jan. 15, 1841.

not in actually opposing directions. The Morrison was from China, bound to New-York; and I have reason to believe that her position at noon may be safely relied on. The violence of the gale was here so great that the ship, as I am informed, was lying to without canvas. This ship had encountered the western side of the gale, suddenly, at 7, A. M., and the sun shone chiefly unobscured during the greater part of the day.

The gale was severe over the entire surface comprised in the map, except, perhaps, on its extreme northern and northwestern portions, and excepting, also, the lighter winds which were observed near the apparent axis of the gale, in the region of Buzzards' and Cape Cod bays, &c. in the afternoon and evening. A very heavy fall of snow accompanied the gale in the states of Connecticut, Rhode Island, Massachusetts, New-Hampshire, and Maine; also, in some parts of New-York and southern Vermont. Some snow also fell in the western and northern parts of New-York and Vermont, but attended with more moderate and variable winds, chiefly from the north and west.

The southwesterly and southerly winds, which connect the westerly with the southeasterly winds in the circuit of rotation, are found at Nantucket in the afternoon, by the farther advance of the storm, and also in the log-books of a number of vessels whose positions were eastward and southward of the ship Morrison, but beyond the limits of the map.

The barometric minimum, as in other storms, appears to have nearly coincided, in its progress, with the apparent axis of the gale.

My main object in collecting the observations contained in the subjoined schedule, has been to establish the course of the wind in the body or heart of the storm at a given time, and apart from all other considerations. I am in possession, however, of more extended observations of this gale. Many of these appear to agree with some of the following characters or modes of action which pertain, more or less, to many of the storms or gales that visit the United States and other regions. These characters have claimed attention from almost the earliest period of my inquiries.

1. The body of the gale usually comprises an area of rain or

foul weather, together with another, and perhaps equal, or greater area of fair or bright weather.

2. The fall of rain or snow often extends, in some direction, greatly beyond the observed limits of the gale.

3. The gale itself not unfrequently exhibits an apparently unequal extent of action, or degree of violence, on different sides of its apparent axis of rotation.

This peculiarity, as well as the second, is most common in winter storms, and in those which sweep over an extensive continental surface; and, like other irregularities, is less noticeable in the storms which are traced solely on the ocean.

4. The barometric indications of a gale commonly extend much beyond the observed limits of its action.

5. The body of the gale constitutes a determinate sheet or stratum of moving air; and of this sheet or stratum a large portion sometimes overlies another and more quiescent stratum of air, the latter having, perhaps, a different motion; as may be often observed in the common winds of the temperate and higher latitudes: in which case the gale is either not felt at the surface of the earth, or the observed changes of wind are found, in part, unconformable to the whirlwind theory.

6. Owing to the convergent and somewhat variable courses of storms in the extra-tropical latitudes, as well as to their unequal rates of progress, two storms will sometimes cover, in part, the same field, one of which will overlie the other, and, perhaps, thin out at its margin, in the same manner as common winds. This, also, may occasion a different order of change in the observed winds and weather from that which is commonly noticed in a regular whirlwind storm.

Owing to such causes, the oscillations of the barometer are often irregular; and this is particularly noticeable in the higher latitudes.

7. In most gales of wind there is, probably, a subordinate motion, inclining gradually downward and inward in the circumjacent air, and in the lower portions of the gale; and a like degree of motion, spirally upward and outward, in the central and higher portions of the storm. This slight vorticular movement is believed to contribute largely to the clouds and rain

which usually accompany a storm or gale; and is probably due, in part, to the excess of external atmospheric pressure on the outward portions of the revolving storm.

8. In storms which are greatly expanded there is sometimes found an extensive area of winds of little force and variable direction, lying within the circuit of the true gale, and attended throughout with a depressed state of the barometer. This more quiescent portion of air in the centre of the gale has been found to extend, in some cases, to a diameter of several hundred miles.

In the case now before us, the direction of the arrows representing the course of the wind at noon, as carefully drawn on a larger map, shows an average convergence, or inward inclination, of about six degrees. But it is not deemed safe to rely upon this result in a single case, which is liable to be affected by the errors of observation and the deflecting influences of the great valleys and lines of elevation, as well as by the errors of approximation which often arise from referring all winds to eight, or, at most, to sixteen points of the compass.

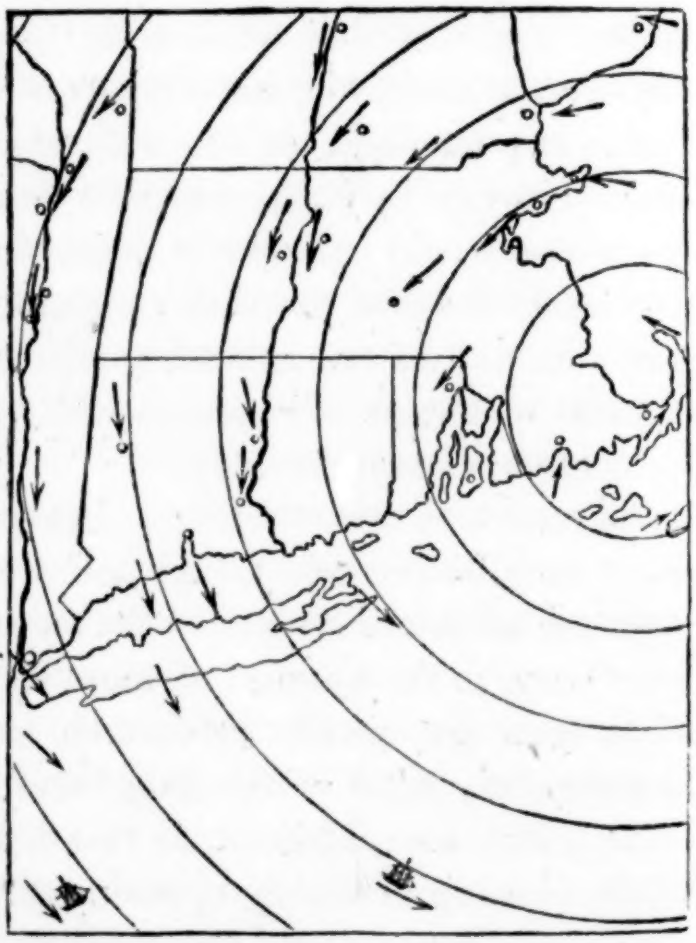
It is not intended, on this occasion, to support the foregoing characteristics by such extended details of evidence as their discussion would necessarily demand; and they are mentioned here only because the true character of the rotation in these gales, as well as the necessary or incidental connection of this rotation with other phenomena which attend them, has seemed to be often misapprehended.

As relates to the whirling or rotary action in the case before us, it may be remarked, that had we obtained no observations from the northwestern side of the axis of this gale, it would have been easy, in the absence of more strictly consecutive observations than are usually attainable, to have viewed the initial southeasterly wind of the gale,* and the strong northwesterly wind which soon followed, as two distinct sheets or currents of wind, blowing in strictly opposing directions; and if we could so far lose sight of the conservation of spaces and areas, the laws of momentum and gravitation, together with a continually depressed barometer within the storm, we might then have supposed one of these great winds, if not both, to have been turned

* Observed between the coast of Massachusetts and latitude 25° N.

upward by an unseen deflection, and doubled back upon itself in the higher atmosphere. But the case neither calls for nor admits these speculations. If, however, the axis of this gale had chanced to pass westward and northward of our limits of correct observation, in pursuing its northeasterly course, as did, perhaps, that of the storm of December 21st, 1836, which has been ably examined and discussed by Professor Loomis,* it is, in such case, more than probable that its whirlwind character would not have been established.

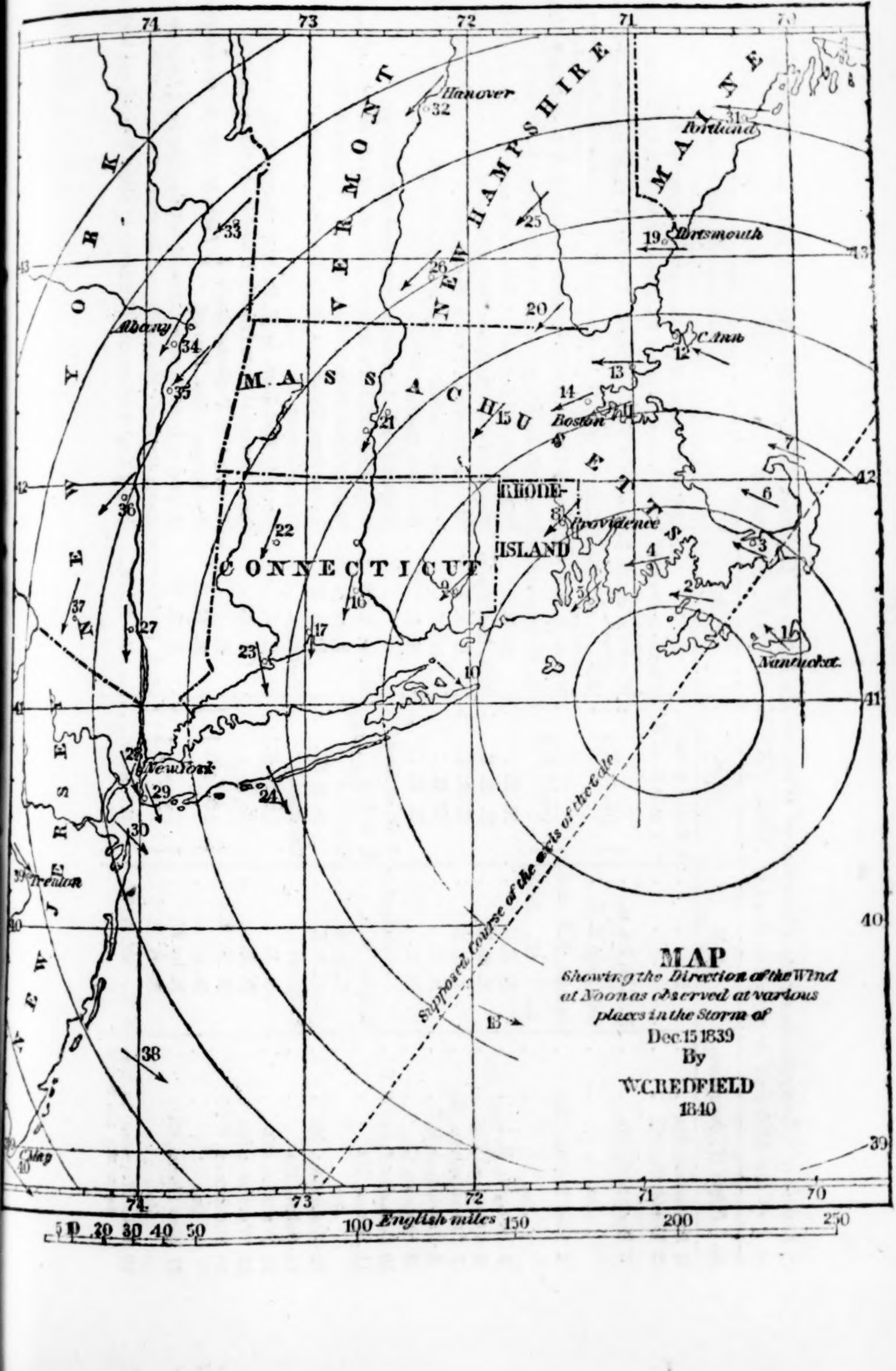
[*Note.*—It having been claimed that this and other storms had been found to blow *inward*, towards some central point or line, I was induced to prepare and make public, shortly after the occurrence of this storm, a statement of observations on the direction of the wind *at or near sunset*, from such evidence as was then in my possession, and illustrated by a small geographical sketch or diagram.



To this sketch, which is here subjoined, I have now added the latest observations on the 15th, at the following places, viz: Culloden Point, Worcester, position of ship Morrison, Stratford, Fire Island, Keene, West Point, Salem, (N.Y.) and the position of the barque Ann Louisa. It will be seen that the assumed axis of the storm on this sketch is more advanced in its northeasterly course than appears in the larger diagram of the observations made at noon, as seen on the following page.

I have seen no satisfactory evidence that the revolving character has been wanting in any active American storm.—W. C. R.]

* Trans. Am. Phil. Soc. Vol. VII. p. 125–163.


NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
NEW JERSEY
Hanover
Portland
Portsmouth
Albany
C. Ann
Boston
Providence
Nantucket
New York
Trenton
C. May
Supposed Course of the axis of the Gale
MAP
Showing the Direction of the Wind at Noon as observed at various places in the Storm of Dec. 15 1839
By
W. C. REDFIELD
1840
English miles

Schedule of Observations on the Direction of Wind in the Storm of December 15th, 1839: With a Map indicating the Direction of the Wind at or near the hour of Noon. By WILLIAM C. REDFIELD.

No.	*Places of Observation.*	*A. M.*	*Noon.*	*P. M.*	*Observers and Authorities.*
1	Nantucket, Ms.	E.	S.E. at 1 *p. m.*	S. W.	Report of James Mitchell, as published by Mr. Espy. [Nantucket.
2	Woodville, Ms.	. . . . .	" A little S. of E."	Clouds broke at W. before 2 P. M.	Observations on board Steamboat Telegraph, by William Mitchell of
3	Barnstable, Ms.	N. E. at 7 *a. m.*	[E. S. E.]	E. at 2 *p. m.*: S. E. at Sunset.	Report to Editor of Boston Courier. } *I take the mean of E. and S. E for true direction at Noon.* W. C. R.
	Do.	Gale from S. E.		S.W. *p. m.*: Clear at Sunset.	Letter of Wm. H. Brown to W. C. R.
4	New Bedford, Ms.	Sunrise, N.E. mod.	[E. by N.]	2 *p. m.* E. N. E.: 3½ p. m. S.	Joseph Congdon's Meteorological Journal. } *I take E. by N. as the mean for Noon.*
	Do.	do. E. fresh,		do. E: Sunset S S E	Sam'l Rodman's. do. as publ'd by Mr. Espy.
5	Newport, R. I.	N. E.	N. E.	N. E.	Meteorological Journal published at Newport.
6	Cape Cod Bay,	E. S. E.	E. S. E.	E. S. E. at 2 *p. m.*	Report of Capt. Slemmer,* Brig Columbus.
7	Provincetown, Ms.	E. S. E.	E. S. E.	E. S. E.	Marine Reports in Boston Newspapers.
8	Providence, R.I.	N. E.	N. E.	N. E.	Professor Caswell's Meteorological Journal.
9	Norwich, Ct.	N. E.	N. E.	N. E.	Norwich Courier.
10	Culloden Point, N.Y.	*"changed to*	*N. W. at Noon."*	. . . . .	Capt. Green's Account, as published by Mr. Espy.
11	Boston, Ms.	Sunrise, N. E.	E. N. E. } [E. 17° N.]	Sunset, E. S. E.	Wm. Cranch Bond's Meteorl. Journal. } *I take the mean of the observations at Noon.*
	Do.	E. by N.	E. by N.	* E. by N.	Robert Treat Paine's Observations.
12	Gloucester, Ms.	E. S. E.	E. S. E.	E. S. E.	Letter from Gloucester, in the Boston Newspapers.
13	Salem, Ms.	Eastward.	Eastward.	Eastward.	Salem Gazette.
14	Waltham, Ms.	N. E.	[E. N. E.]	E.	Monthly Met. Jour., by C. F., in the Boston Daily Centinel.
15	Worcester, Ms.	N. E.	N. E.	N. E.	Met. Journal at State Lunatic Hospital—in National Ægis.
16	Middletown, Ct.	N. N. E.	[N. by E.]	N.	Reported by Professor Smith. } *I take N. by E. for the mean at Noon.*
	Do.	N.		N. N. E.	Dr. Barratt's Met. Journal.
17	New Haven, Ct.	N. by W.	[N. 3° E.]	N. N. W.	Report of Capt. Woolsey, Steamboat Providence. } *I take the mean of N. 3° E.*
	Do.	N. N. E.		N. N. E. till 1½ *p. m.*	Judge Darling's Meteorological Journal.
18	Ship Morrison, at sea: Lat. 39° 35 N. Lon. 71° 50 W.	S. E.: W. N. W.	W. N. W.	W. N. W.	Ship's Log Book—also, Statements of Capt. Benson and his Officers.

No.	Places of Observation.	A. M.	Noon.	P. M.	Observers and Authorities.
19	Portsmouth, N. H.	E.	E.	E.	Weekly Meteorological Journal, published at Portsmouth.
20	Nashua, N. H.	N. E.	N. E.	N. E.	Nashua Telegraph.
21	Northampton, Ms.	N. E.	[N. N. E.]	N. E.	Observations of W. Atwill and others. *I assume the approximate mean*
	Amherst, Ms.	N. by W.		N. by W.	Professor Snell's Met. Journal. *of N. N. E. for Noon.*
22	Litchfield, Ct.	Night of 14, 15, N. E.	[N. N. E.]	N. at Night of 15th.	Litchfield Enquirer. *Assumed mean for noon of 15th, N. N. E.*
23	Stratford, Ct.	N. by W.	N. by W.	N. by W.	Rev. J. R. Linsley's Meteorological Journal.
24	Fire Island Beach, N. Y.	Midnight, N. E.: veered by N.	N. N. W.	N. N. W.	Captains Cartwright and Skiddy, employed at the Beach.
25	Concord, N. H.	Northeasterly.	N. E.	N. E. and more N'ly	Letter from Concord to S. G. Arnold; from Mr. Arnold.
26	Keene, N. H.	N. E.	N. E.	N. E.	Rev. Z. S. Barstow's Meteorological Journal.
27	West Point, N. Y.	N.	N.	N.	Meteorological Journal of the Medical Department.
28	New-York City,	N. by W.: N. N. W.	N. N. W.	N. W. by N.	Meteorological Journal of W. C. Redfield.
	Fort Wood, N. Y. Harbor	N.	[N. N. W.]	N. W.	Met. Journal of Medical Officer. *Mean of N. N. W. taken for Noon.*
29	Flatbush, N. Y.	N.	[N. N. W.]	N. W.	Rev. T. M. Strong's Met. Jour. *Mean of N. N. W. assumed for Noon.*
30	Sandy Hook Bay, N. Y.	N.	N. W.	N. W.	Log Book of Bark Osceola.
31	Portland, Me.	N. E.: at 11 E.	[E. 6° S. mean.]	E. by S.	Met. Report of Keeper of Marine Observatory: Published at Portland.
32	Hanover, N. H.	N. E.	[N. E.]	N.	Professor Young's Meteorological Journal.
33	Salem, N. Y.	N. E.	N. E.	N. E.	William Brand and W. Larkin; Meteorological Journal.
34	Albany, N. Y.	N. E.	[N. 28° E.]	N. E.	T. Romeyn Beck, M. D. Met. Journal. *Mean assumed for Noon,*
	Lansingburgh, N. Y.	N. N. E.		N.	E. T. Foote, Meteorological Journal. *N. 28° E.*
35	Kinderhook, N. Y.	N. E.	N. E.	N. E.	Silas Metcalf, Meteorological Journal.
36	Kingston, N. Y.	N. E.	N. E.	N. E.	Isaac Blauvelt; Meteorological Journal. *[noon, N. N. E.*
37	Goshen, N. Y.	N. E.	[N. N. E.]	N.	Nathaniel Webb and John S. Crane; Met Jour. *Mean assumed for*
38	Bark Ann Louisa, off Absecom, N. J.	W. N. W.	N. W.	N. W.	Ship's Log Book, and Statement of Capt. Wilson.
39	Trenton, N. J.	N. W.	N. W.	N. W.	Dr. E. A. Ewing's Meteorological Journal.
40	Cape May, N. J.	N. W.	N. W.	N. W.	Marine Reports, and Letter from Cape May, in Philad. Newspapers.

Abbreviations.—N. H. State of New Hampshire; Me. Maine; Ms. Massachusetts; R. I. Rhode Island; Ct. Connecticut; N. Y. New-York; N. J. New Jersey.——*Note.* My own observations on the 15th P. M. have on a former occasion been erroneously printed N. W. by *W.*; for which read N. W. by *N.*

NEW MATHEMATICAL INSTRUMENTS.

An instrument has lately been invented by Mr. J. A. Powers, which, from the general nature of its application, promises to be of great utility. It is in the form of an octant, or one-eighth part of a circle, and it will be readily appreciated by the mathematical reader, from the following brief outline of its construction.

We shall, for perspicuity sake, call one radius, A B, the other, A C. The radius A B is decimally divided, and from each point of division, perpendiculars are elevated and produced until they intercept the radius A C; and from each point of intersection in A C, lines are drawn parallel to A B, and produced until they meet the arc. A metallic index of the same length, and graduated in the same manner with A B, is moveable about the centre A. The arc or limb is divided into degrees and points, which are numbered in the following manner: the degrees are numbered from B, in the direction of C, from 1° to 45°, and back from C, in the direction of B, from 45° to 90°; the points also are numbered in a similar manner.

Hence it will be perceived, that the instrument is, of itself, a complete trigonometrical canon, and may be used with facility and precision to solve the various cases in trigonometry, and the different problems in plane and traverse sailing, &c. It may also be used to construct various arithmetical and trigonometrical tables, with rapidity and correctness.

NOTICES OF NEW PUBLICATIONS.

A Dictionary of Arts, Manufactures, and Mines, containing a clear Exposition of their Principles and Practice. By ANDREW URE, M. D., F. R. S., &c. &c. *Illustrated with* 1241 *Engravings.*

It was stated in the last number of the Repertory, that this very valuable work would be republished here in 21 parts, at 25 cents each. We have since received from the publisher, Mr. La Roy Sunderland, No. 126 Fulton street, Part I, printed upon excellent paper, with clear type, and well executed engravings.

This is not simply a dictionary of arts, written up to the present state of knowledge of the branches upon which it treats, but it contains much information of a kind not hitherto embraced in similar works, not the least important of which is that relating to chemical manufactures.

PROGRESS OF SCIENCE.

Notices of the Meeting of the Italian Scientific Association, held at Florence, in September, 1841.

Nothing* could have gone off better than the meeting here, which lasted a fortnight, and at which nearly 900 persons enrolled their names. Twenty-two British subjects entered their names, among whom were R. Brown and Mr. Babbage. I arrived here on the 14th September, the day before the Congress assembled, and on enrolling my name received a card, on the presentation of which all the public institutions of Florence were open to the members, with a small book and map of the city, prepared and printed expressly for the occasion. On the 15th, the first meeting was preceded by a mass in music, performed in the church of Santa Croce, the Florentine Pantheon, where all the savans and most of the aristocracy of Florence were present; the effect was very grand in the midst of the tombs of Machiavelli, Michael Angelo, and Galileo, and surrounded by the *chefs d'œuvre* of Giotto, Gaddi, and the other founders of the Florentine school of painting. From the church we adjourned to the great hall of the Palazzo Vecchio, constructed for the purpose of assembling the Florentine citizens during the Republic, and which, for nearly three centuries, had never witnessed so numerous an auditory. There, in the presence of the Grand Duke and his family, the President, the Marquis Ridolfi, opened the business of the Congress by a very good speech, which elicited general and well-merited applause. This done, the members repaired to another building, the Museum of Natural History, to be present at the inauguration of the statue of Galileo, and to divide themselves into sections and name their officers. I must first of all say a few words respecting the Tribune of Galileo. The present Grand Duke of Tuscany, Leopold II, is one of the sovereigns of the present day who has done most, compared with his means, to encourage the arts and sciences in his state. Among other things, he has collected, at a very great expense, not only every MS. of Galileo he could procure, but also those of his pupils, who formed the celebrated and too short-lived Academia del Cimento, as well as the instruments used by Galileo and his followers, and by means of which they founded the modern school of experimental philosophy. Having done this much, Leopold II determined to raise a monument to his immortal countryman, and to inaugurate it on the occasion of the Italian Association for the advancement of science assembling at Florence; and to place in a tribune, dedicated to Galileo, every thing that had been collected relating to him. The Museum of Natural History, which contains also the observatory and the cabinet of philosophical instruments, and which adjoins the grand ducal palace, was selected as the site of this temple to the cause of science in the person of its greatest founder. It forms a beautiful tribune, with a magnificent statue of

* Letter from a Correspondent of Jameson's Journal, dated Florence, October 18, 1841.

Galileo in the centre, surrounded by niches, in which are placed busts of his pupils, and with presses containing the instruments with which he made his greatest discoveries. The walls are inlaid with marble and jasper, a kind of work for which the Florentine artists are so celebrated, and the ceiling painted by the first artists of the day, representing different events in the life of the Tuscan philosopher. Every thing that art and taste could effect to render the edifice worthy of its object has been done, and the result has been admirable. What the world does not know generally is the great sacrifice which the Grand Duke has made for this monument. I have been assured that the outlay hitherto (and there still remains something to be done to complete the tribune), amounts to £36,000 sterling, not including the purchase of the manuscripts of Galileo above alluded to—what an example for more powerful sovereigns! To return to the Congress,—it divided itself into five sections, viz. Agriculture, Medicine, Geology, Mineralogy, and Geography; Natural Philosophy, Mathematics, and Astronomy; Zoology and Botany. The sections met at different hours; those of Agriculture, Natural Philosophy and Medicine, being the most numerously attended. The Grand Duke and his Duchess attended one or more of the sections every day without any state or ceremony. The greatest good humor prevailed at all the sections, and I was astonished to witness the great facility with which the Italian savans spoke on the most abstruse subjects. In the geological section we had some very good papers on Italian geology, and several interesting discussions. I took some part in the latter, having, during my former journeyings in Italy, attended much to the subject, and I communicated at the first meeting a brief outline of Ross's brilliant discoveries in the Antarctic regions, which created subsequently a good deal of interest in Florence. On another occasion I gave a sketch of the geology of the Andes, as compared with that of some other mountain regions, and especially with the Appenines by which we were surrounded. We had all the best Italian geologists present, viz. Passini, Pareto, Savi, Sismonda, and Collegno. At our recommendation the Grand Duke has consented to found at Florence a Geological Museum, to contain a collection from every part of Italy, accompanied with sections, maps, and everything necessary to convey an accurate idea of the physical constitution not only of Tuscany, but of every other state of the Peninsula. He will pay all expenses and the salaries of the curators; and the different geologists will be invited to send duplicates of their collections. His highness has consented to found a similar central museum, for the vegetable productions of Italy, which will contain an herbarium of its different regions. This generous conduct on the part of Leopold II will give you some idea of the liberality and enlightened views of the sovereign of this happy state, who, I may say without exaggeration, is most sincerely beloved by all classes, from the peasant to the highest nobleman in his dominions. Our meetings continued every day, except Sundays, until the 30th, and every one saw their approaching termination with regret. We geologists made some very pleasant excursions in the neighborhood, and wherever we went, dinners were prepared for us by the gentry of the vicinity. Towards the close of the Congress the Grand Duke, who, during its continuance, had invited (in parties of twenty) several of us to his table, gave a grand

banquet at one of his villas close to Florence (Poggio Imperiale) to the whole Association. The dangerous state in which his eldest daughter then was (she died three days afterwards), prevented his being present; but the great officers of the household did the honors, and nearly one thousand persons sat down to dinner in the most perfect order. On the last day of the meeting, a general assembly of the Italian members (foreigners not being allowed to vote) took place, to fix the place of assembling in 1843, in consequence of the Ex-Empress Maria Louisa, who now governs Parma, having refused her sanction to the Association going to Parma, as previously agreed upon. Lucca was selected, and the Duke of that principality has given his consent. In 1842 the Association will assemble at Padua, where I think it will meet a kind and hospitable reception, although we cannot expect to be treated as we have been here; but Padua, nevertheless, offers many facilities in its extensive university, and its environs have many points of attraction for the geologist in the Euganean hills, and the tertiary deposits of the not far distant districts of Verona and Vicenza, whilst I believe that the Austrian authorities, far from setting their face against the Association, as those of Rome and Naples have done, will do every thing to encourage it. A medal has been ordered to be struck to commemorate the Florentine meeting, a copy of which was given at its close to each of its members, in silver, to the Presidents, Vice-Presidents, and Secretaries, and in bronze to the other members. In addition to this, the Grand Duke in his liberality had printed a new and enlarged edition of the acts of the Academia del Cimento, and an illustrated description of the Tribune of Galileo, of both of which copies were presented to all members not Florentine, on going for their passports, and have been given since to many of the latter. An account of the proceedings of each day, with a list of new members, was printed every morning and sent round to all the *scienzati*, and in a few weeks a large volume will be published containing the detailed proceedings of the Association. From France we had M. de Blainville for a few days; from Belgium the king sent a formal mission in the person of Professor Morren of Liege, the botanist; and from Germany there were the venerable and excellent botanist Link, of Berlin; Charpentier, the geologist of the Pyrenees, and of the modern glacier theory; Professor Mahlmann, of Berlin; Mittermayer of Heidelberg, and others. We had also a few Americans, Greeks, and Spaniards, and a Spanish American medical man. As to Italians, the number would have been greater had not the Roman and Neapolitan governments opposed the coming of their subjects. Several, however, eluded the prohibition, and amongst others Tenore the Neapolitan botanist; as to Austria and Sardinia, every facility and encouragement were afforded to those who wished to be present on the occasion. The result of the Florentine meeting has been to bring Italians together after a lapse of some centuries, and to give an impulse to science throughout the peninsula, which, I am persuaded, will be attended by very beneficial results. We know what have been the good effects of such ambulatory meetings in Germany and Switzerland within the present century; and in Italy, placed as its inhabitants are, under different governments, whilst speaking the same language, I think we are justified in anticipating equally profitable consequences, considering the

genius of the people, their past history as regards literature, science, and the arts, and the protection of the principal sovereigns, as already evinced by those of Austria, Piedmont, and Tuscany. As to the immediate scientific results of the meeting, several very good papers were presented on geology, botany, and zoölogy, and some very interesting researches on magnetism and mechanics in the physical section.

We* owe to the kindness of M. Matteucci an extract from the minutes of the meetings of the physical, mathematical, and chemical sections, of which he is the secretary.

M. Pacinotti read a memoir on the induced currents which are developed in magnets put in rotation. After having studied the principal circumstances of this phenomenon, he showed how it may be made use of in order to study the distribution of magnetism in a magnet, and in order to have a current of constant power; and how also suitably, in bringing together several magnets in rotation, we may have a very powerful electrometer.

M. Cagnozzi read a memoir on tonography. He presented an instrument which he calls a *tonographe*, and with which he proposes to write down the music of declamation.

M. Vegui showed some *wire ropes* (*cordes en fil de fer*), in the centre of which there is a cord of hemp: it appears that this modification destroys the rigidity of ordinary wire ropes.

Professor Cassiani of Parma read a memoir, the object of which is the study of the oscillatory motion observed long since in an astatic system of magnetic needles. He finds that this motion is connected with the electric state of the atmosphere.

Prince Louis Bonaparte exhibited some platina gilt by De la Rive's process, and observes that this metal takes the gilding better than silver. He explains this, on the one hand, by the greater density of the platina, and, on the other, by the insoluble layer of chloride of silver, which must withstand the perfect gilding of silver.

M. Matteucci spoke of the experiments lately made in England, and of those of M. Peltier in France, according to which the vapor of water appears to him to manifest a state of electricity, when it is formed at a high degree of tension and at very elevated temperatures. He afterwards noticed the observations which he has made for the purpose of studying the electric state of the atmosphere near the columns of vapor which rise in the Lagoons of Tuscany, where boracic acid is produced. He says that he has not observed any difference, with respect to electricity, between the air near the Lagoons and that at a great distance from them. From this he concludes, that we cannot consider the slow evaporation of water from salts, or from the sea, as the cause of atmospheric electricity.

M. Vincent Amici extends the principle of virtual velocities, and of living forces, to liquids which are acted upon by any forces whatever in their elements, and compressed at their surface.

M. Majocchi communicated a series of experiments, the result of which is that heat, whether conducted or radiating, is endowed with

* From the *Bibliothèque Universelle*, No. 69, October, 1841, p. 205.

the same property which M. Becquerel, jun. found existing in those rays of the spectrum which he has named *continuateurs*. It is thus that he has discovered that photogenic papers submitted to the action of light during an exceedingly short time, and without their undergoing any action, change if they are heated in any way whatever.

M. Perego related his experiments on the development of electricity by the immersion of bodies in mercury. One of the substances which succeed the best is the *felt* used in making hats.

M. Mossotti read a memoir on the explanation of the dispersion o. light in the undulatory theory.

M. Dini communicated some experiments relative to the influence of heat on capillary attraction.

M. Orioli communicated the observation of a kind of light seen by an individual on his toes. M. Boyer noticed a similar observation. These two physicists explain these phenomena by supposing a morbid secretion of electricity. M. Matteucci cannot admit this explanation, not seeing how a luminous electric charge can be preserved without discharging itself upon bodies which are in contact; he thinks that these phenomena should rather be referred to those which relate to the phosphorescence of rotten wood, fish, &c.

M. Matteucci exhibited an apparatus for electrostatic inductions. He describes an apparatus which he calls a differential inductometer, and which is composed of a spiral plane placed between two similar spirals; these may approach more or less to the intermediary spiral, and their extremities may be united together so as to produce two currents which circulate in contrary directions. He mentioned some contrary results which he found in studying these induced currents by means of magnetizing, by the galvanometer, and by the hole made in paper by the spark of induction.

M. Pacinotti described two experimenta which appeared to him contrary to the theory of Ampère. He has a cylinder of soft iron, which is hollow; he introduces into the internal central part of this cylinder a spiral, and places a similar spiral at the exterior. M. Pacinotti has found that the current of the external spiral does not give an induced current in the internal spiral, and that a current in the internal spiral does not magnetize the cylinder of soft iron.

M. Mahlmann of Berlin read an extract from a work on the distribution of heat on the surface of the earth.

M. Giazi read a description of the effects produced by lightning. He exhibited some pretty vitrification of stones, some black and yellow traces left on a wall, and a nail magnetized by means of the thunder stroke.

The Count Scopoli mentioned the cause of the inundations of Lombardy, and added to the known causes the slow destruction of certain artificial lakes which are found on the declivities of the mountains.

MM. Stefani and Jordani presented models of *electric telegraphs*, and of *electro-magnetic telo-typographs*.

M. Cini exhibited a singular reproduction of a drawing, which is produced at the end of a certain time on the plate of glass which covers this same drawing.

M. Marianini read a summary of the experiments made by him on

induction. He thinks he can establish as a fact, that the current of induction is developed in the metallic thread, the circuit of which is closed an instant after the voltaic circuit has been shut or opened. ' He believes, that by following up these experiments he shall be able to connect the principle of electro-dynamic induction with that of the influence of the electricity of tension.

M. Matteucci mentioned his experiments on the current yielded by the frog, and described some new experiments on the torpedo.

M. Carlini spoke of the use of the barometer in the measurement of heights, and described an apparatus for the purpose of having the level of the mercury constant.

M. Marianini read the history of two cases of paralysis which were completely cured by the use of dynamic electricity, applied in an intermittent manner.

M. Zantedeschi confirmed the experiments of M. Matteucci on the torpedo; he thinks that the nerves come from the dilation of the *medulla oblongata*, which forms the fourth lobe, with the gray matter which covers it. M. Savi has also made the observations.

M. Morren has found phosphorus in glow-worms, as well as a system of prisms or transparent lenses above the luminous matter.

Professor Gonnella* presented some printed memoirs, in one of which appears the theory and the description of a machine for measuring plane surfaces, which he had invented and constructed in 1824, and an abridged memoir of which he had published in the *Antologia* for 1825. In another of these memoirs he gives a theory of new systems of eye-pieces of arbitrary lengths for the Newtonian telescope, and for spherical as well as for parabolic object-glasses, according as is best suited for artists. In reducing for each telescope the length of the tubes of the eye-pieces greater than the semi-diameter of the object-glass, we may substitute for the small plane metallic mirror a rectangular prism of glass, very small, of whatever may be the opening of the object-glass, since the prism may be placed very near the focus without the eye of the observer being obliged to be within the great tube; for the length of the eye-piece determines the place of the eye on the outside of this same tube. We thus obtain the power of constructing the best telescopes, with the prism, as pointed out by Newton, of large dimensions; for, the prism being very small, we may,—1st, easily find pieces of perfect glass for them; 2d, we may have the total reflexion of the rays, since the quantity of light absorbed by the thickness of the prism is insensible; 3d, we may obtain the advantage that the loss of the central rays of the object-glass intercepted by the prism shall be very small in relation to the diameter of the object-glass, and always smaller relative to the greatest diameters; for the size of the prism is always constant for all the object-glasses, viz. about an inch for each side of the right angle of the rectangular triangle which forms its base. In short, it only remains for us to observe, that the telescopes with the prism have double the clearness of those which have the small plane metallic mirror.

* This notice is extracted from a letter addressed by Prof. Gonnella to Mr. Babbage, and kindly communicated to us by that gentleman.—*London and Edin. Phil. Journal.*

Comparative observations on the principles of Warming Houses, Churches, Manufactories, Conservatories, and all extensive Buildings, by means of Heated Water. *By* Dr. Wilkinson, *Bath.*

The quantity of water in pipes of different dimensions is in the same lengths proportionate to the square of their respective diameters, whilst the radiating surface is only in the simple ratio of their diameters; thus a gallon of water being equal to 231 cubic inches: supposing the thickness of metal to be $\frac{1}{4}$ inch in a 4 inch pipe, it will require 2 feet in length to hold 1 gallon.

The inch pipes employed by Perkins are of the same thickness, so that the tubular part is half an inch in diameter, and hence will require 49 times the length of pipe to contain 1 gallon equal to 98 feet, such being as the square of $3\frac{1}{2}$ inches to $\frac{1}{2}$ inch, being 49 times greater in length, whilst the surfaces exposed are only as 8 to 1, and therefore, supposing the water in each pipe be preserved at the temperature of boiling, viz. 212°, it will only require 16 feet in length of the smaller pipes to expose the same surfaces as 2 feet of the larger; it is hence evident that only one third of the quantity of water is required, and a proportionate saving of metal and fuel.

In pipes of four or more inches in diameter, the boiling point of water is rarely exceeded, whilst the lowest degree of temperature in the small pipes employed by Perkins is 800°, or more than three times the heat of boiling water, and in a similar proportion the radiation of heat is increased, and with the same increased rapidity warmth is transmitted to different apartments. About two years since, I was requested by the Duke of Beaufort's agent to make some experiments on the mode there adopted for warming Badminton, and we could not succeed in raising the temperature in the library and the conservatory more than 10°; this apparatus was removed, and the small pipe system adopted, every required warmth is now obtained, with less than one third of the fuel before used. A similar case occurred in a large room at the British Museum, which I visited with Mr. Perkins; the large pipes, being found inadequate, were removed, and, I was informed, weighed more than 7 tons, whilst a superior heat was transmitted by the employment of only 15 cwt. of small pipes.

There is also a material difference in the time required for the distribution of heat; many hours are necessary for the production of that temperature by large pipes, which is accomplished in one hour by small pipes.

In some situations pipes pass through cold passages, and in intense weather subject the water to be frozen, in consequence of which, the circulation being prevented, the pipes in the furnace become softened, and give way to the pressure of the heated fluid; the water is converted into expansive steam, and if, as occurred last winter in Manchester, the furnace is imprudently placed in a depôt of combustible materials, danger is incurred; the warming apparatus in this case appears to have been very indifferently arranged, and not under the direction of the patentee, Perkins. To guard against any such results, Mr. Perkins at-

taches to his apparatus a safety valve, and when high heat is employed, all danger from obstructions of the kind are most effectually prevented.

It appears that the fire took place on a Monday, so that during a very intense frost, the fire was extinguished for two nights and a day, while, if a gentle combustion had been preserved in the furnace during that time, sufficient heat would have been produced to prevent any freezing result. In my own residence I have adopted Mr. Perkins's plan, and by means of a single coil of pipes in the entrance passage, during the last inclement winter, at an expense not exceeding sixpence per day, sufficient heat was radiated from the single coil, so that every room in the house was at a temperature between 50° and 60°, and it will give me at all times great pleasure to show and to explain the principles of of the apparatus to any person desirous of introducing into his house this most agreeable, and, in my opinion, perfectly secure mode of warming houses.

I have no comparative observation on the employment of heated air —on every principle the effects are not only unpleasant, but also injurious.

Electro-Magnetic Engines.—New System of Action suggested. [From a Correspondent of the Mechanics' Magazine.]

Considering the principle and constructions of electro-magnetic engines, it became a question whether the power obtained is used in the best manner, and to the best effect; in other words, whether the place of rotating magnets may not be supplied by some better arrangement.

It would seem that force exerts itself naturally in straight lines only; and when forced from that straight line much friction and loss of power ensues. Thus steam issues from any opening in a straight line, or even if passed through a tube bent to an arc of a circle, it still issues from the mouth in a straight line. Steam engines may be divided into three great classes, differing in effectiveness. First in order stands the Cornish engine, in which the motion is almost entirely in straight lines; next comes the crank engine, in which the motion is communicated to the piston in a straight line; last of all comes the rotative engine, which has never yet been found so available as either of the former, notwithstanding the ingenuity and talent spent upon it.

This train of thought led me to consider whether an arrangement could not be made in the electro-magnetic engine, on the principle of the reciprocating steam-engine. The result was the formation of a plan entirely new to myself, and the merits of which I leave your readers to decide upon. I have commenced a small model, upon which I purpose to experiment, and of which I will send you a drawing, together with the results of such experiments.

I propose that the magnet—be a straight bar of iron, round which the wire from the battery is to be coiled as usual. Two pieces of iron are to be fixed to a frame capable of moving freely backwards and forwards, the pieces of iron or alternators being exactly opposite the ends of the magnet, and the distance between them being equal to the length of the magnet, and length of stroke added together. The frame will turn a

fly-wheel, by means of a connecting rod and crank, and upon the axis of the fly wheel will be an eccentric, which will move the inversor, and reverse the current. Suppose now the negative pole of the magnet to be to the right, and the positive pole to the left, the connection with the battery having been made; the alternator and frame will now move to the right, turning in its progress the fly-wheel, shaft, and eccentric, which, when the stroke is completed, will reverse the current by means of the inversor. The poles being now reversed, the frame will now move back into its first position, and the current being again reversed, the motion will continue.

Experiment alone can test the value of this arrangement, and I have been induced to send this communication thus early, in order that those of your readers who may have it in their power, and think it worth their trouble, may test it more fully; feeling in my own mind that self interest should never intrude itself as an obstacle to the furtherance of objects so vast and important to every one, and which indeed surpass in their magnitude our highest and most sanguine thoughts.

Description of an Electric Thermometer. By E. Solly, *Jun. Esq In a letter to the Lond. and Edin. Phil. Journal.*

I am induced to send you the following account of a little thermoelectric arrangement, believing that it may be interesting to some of your readers; for although there is little or no novelty in the principles on which its action depends, I am not aware that it has been before practically employed.

I had for some time experienced considerable inconvenience in conducting certain experiments requiring a long-continued and uniform degree of heat, from the difficulty of regulating the temperature of my furnace, and the constant uncertainty whether everything was proceeding satisfactorily during my absence from the laboratory. I had in consequence often thought of the possibility of so arranging a little thermo-electric apparatus that it might serve as an index of the rate of combustion and consequent heat of the furnace, by the deflection of a galvanometer at a distance from the source of heat. A small thermoelectric battery might be so placed that the one series of joints or solderings should be constantly exposed to the heated surface of the furnace; but a serious obstacle presented itself to any contrivance of this kind, which was the difficulty of keeping the alternate joints of the battery cool: a current of electricity would doubtless be evolved in consequence of the difference of temperature existing between the two sides of the battery, but of course as the heat would gradually traverse from the hotter to the cooler side, it would greatly diminish and modify the results, and thus present false indications of temperature; whilst even if it were possible to keep the one side of the battery cool, either by water or by any other means, yet the value of the deflection of the galvanometer would be always uncertain, as the difference between the two sides of the battery could never be ascertained unless the exact reduction of temperature thus caused were correctly known.

After one or two unsuccessful attempts to overcome this objection,

I laid aside the battery and substituted in its place a single pair of metallic elements, which I found gave abundance of power, and was not liable to the defect which the use of the battery involved.

A piece of copper wire, one twenty-fourth of an inch in diameter, and of sufficient length to reach from the furnace to my ordinary sitting-room, was joined by twisting the ends to a similar wire of soft iron, the ends of both having been previously well cleaned with sand-paper. The two wires were then secured in a convenient manner by small nails to the walls of the rooms they had to pass through, care being taken that they were not anywhere in contact with each other, except at the two extreme points of junction; the one of these was so placed in the flue of the furnace that it was completely exposed to the action of the hot air, and smoke at that part where the flue left the body of the furnace, whilst the other joint was in my room in contact with a thermometer, and surrounded with cotton, so as to render it as little as possible liable to sudden changes of temperature. The copper wire was then divided about a foot from the joint thus protected; the two ends of the wire were connected with the extremities of the galvanometer coil, and the apparatus was complete.

A metallic circuit was thus made, consisting of two elements, the one being the iron-wire, and the other the copper-wire, including the additional length of copper wire in the coil of the galvanometer. The one joint or point of contact was of course always far hotter than the other, and would necessarily remain so, so long as the fuel in the furnace continued to burn, and would be dependent on the rate of combustion in the furnace; whilst the other junction would always remain very nearly at the temperature of the air, and its variations could be readily known by the thermometer in contact with it. A current of electricity was thus generated, proportioned to the difference of temperature between the two joints, and the deflection of the galvanometer was caused, which increased when the furnace became hotter, decreased when it cooled, and at all times indicated accurately the changes of temperature taking place, thus giving me a thermometer which indicates, without my moving from the table, the exact rate of combustion going on in the furnace, which is fifty yards distant from the indicator. I believe that it is commonly supposed that weak thermo-electric currents cannot be well made to traverse small wires of any length, and this is probably the reason why this beautifully manageable power has been so little employed for practical uses. I have received so much satisfaction from the arrangement just described, that I am convinced it would be found a very useful indicator of temperature in stoves, flues, and hot pipes, in many situations where a common thermometer is inapplicable.

The cost of such an apparatus must necessarily be more expensive than any thermometer, but then it must be remembered that it does far more than an ordinary thermometer, giving us the means of knowing the temperature of a stove or furnace at a distance, giving us indications of the least change or variation in the source of heat, with even greater certainty and distinctness than a thermometer; and besides, showing these changes so rapidly that we know whether it is becoming hotter or colder, before a thermometer placed on the outside of the stove

indicates any change. I have observed, on comparing the thermo-electric with an ordinary thermometer placed on the iron plate forming the top of the furnace, that if the ash-pit door were closed, or the draught in any other way diminished, the deflection of the galvanometer was immediately reduced, whilst the external thermometer continued to rise for some little time; and that the indications given by the galvanometer of the augmentation or decrease of temperature in the furnace, always preceded the same indications from the mercurial thermometer on the top.

On Color as applied in Decoration. By HYDE CLARKE, F. L. S., &c. [Extracted from Civil Engineer and Architect's Journal.]

At the present period, when so much interest is excited as to the decoration of our public buildings, and when a better epoch for this department of art seems opening, the subject of the laws which regulate it can scarcely fail to be attractive to the profession, as the theory of color and its relations to heat and electricity have been already explained in this Journal, (Vol. II, p. 288,) we can at once consider the practical portion of the subject; but I should first wish to call attention to M. Chevreul's theory of contrast, with some few remarks I have to make upon it. M. Chevreul says (De la Loi du Contraste Simultané des Couleurs: par M. E. Chevreul, Membre de l'Institut,) that where the eye sees at the same time two contiguous colors, it sees them as dissimilarly as possible, both as to their optical composition, and as to the depth of their tone, so that there may be at the same time simultaneous contrast, properly so called, and contrast of tone. Thus if two colors *a* and *b* are in juxtaposition, they will differ as much as possible from each other when the complement of *a* is added to *b*, or the complement of *b* added to *a*. If we choose for our experiment orange and green, and if we place orange by the side of green, blue, the complement of the orange, is added to the green, which thus becomes more blue and less yellow; and so similarly the red, the complement of green, is rendered more vivid in the orange, which also becomes less yellow. M. Chevreul has not suggested the cause of this remarkable phenomenon, but I am myself inclined to attribute it to a tendency which the colors have to balance each other, in a manner like to that in which heat diffuses itself from a heated body to one of a lower temperature, and similar to the law of electrical distribution. If this should be the case, it would also be confirmatory of a homogeneity of color, which many other circumstances would lead us to believe, so that light, instead of being considered to be composed of three simple colored rays, would, according to that view only, owe the phenomena of color to the different arrangement of its particles; as ponderable substances, according to the arrangement of their molecules, vary their forms. Color, perhaps, after all, is only dependent on electrical action, and could we establish this, our way would be clear to the production of colored representations by electricity, instead of the present daguerréotypes, and to many of the operations of dyeing.

Pursuing his remarks M. Chevreul says that it is evident that the phenomena of simultaneous contrast would increase the brightness both

of *a* and *b*, and make them appear more brilliant than they would when looked at isolatedly. If the colors brought together belong to the same group of rays, and only differ in intensity, the clearest in tint will appear still clearer at the point of contact, while that deepest in shade will appear deeper, the tints will be regularly affected from the point of junction, the one set lighter and the other deeper. Colored and white bodies, when put in juxtaposition, become, the former more brilliant and deeper, and the latter of the complementary color of the others. Thus green and white: red, the complement of the green, is added to the white, and the green appears deeper and more brilliant. In this juxtaposition of colored and black bodies, the effect of the contrast of intensity is to deepen the black and lower the tint of the juxtaposed color; but a very remarkable fact is the weakening of the black itself, when the juxtaposed color is deep, and of such a kind as to give such a bright complementary color as orange, yellowish orange, greenish yellow, &c. for instance, with blue and black, orange, the complement of the blue, is added to black, the black becomes lighter, and the blue is clearer, perhaps greenish. All gray bodies contiguous to colored bodies may present the phenomena of contrast in a manner more sensible than white and dark bodies do. Thus yellow and gray: the gray takes more of a violet cast by receiving the influence of the complement of the yellow, and the yellow appears more brilliant, and yet less greenish.

Besides this simultaneous contrast of colours, M. Chevreul distinguishes a successive contrast of colors, by which he means all those phenomena which are observed when the eye, having for some time looked on one or more colored objects, perceives, after having ceased to look at them, images of these objects presenting the complementary color which belongs to each. He also defines a mixed contrast, which is the result of the two others, it takes place when, having looked at a red paper, for instance, and we turn towards a blue, it will appear greenish; if, on the other hand, we look first at the blue, and then at the red, the red will appear orange. These are all well known phenomena, but M. Chevreul makes a practical application of them; he recommends the painter not to keep his eye too long fixed on his model, and the purchaser of colored goods to be similarly careful, if he wishes to keep his eyes in a normal state to look at the last pattern, otherwise the several patterns will, after the first, appear faded, and less fresh in color, although they may all be of the same quality. A shopkeeper who shows several silks, say red, should show others of a complementary color, green in this case, in order to restore the eye to its normal state, and better to prepare it for the red, by making the red look more brilliant than it really is.

I shall now make another halt to give a hint to those of my readers who consult French works as to the use of several words used by the authors: thus *ton* we call intensity, tint and shade; *gammes*, the key color or tone, and *nuances*, hues. Two or three useful rules I shall also advert to here. The best contrast, it must be remembered, is produced by the complementary color, and all colors must be of the same intensity.

When two colors do not agree, it is best to separate them by white.

Black is also useful for this purpose when applied with bright colors, and, in some cases, preferable to white.

Black may be advantageously applied with sombre colors, and with some of the dark tertiaries.

It will now be necessary to consider the several colors separately, in doing which I shall principally avail myself of Mr. Hay's work on color,* the best and cheapest practical work on the subject, and one which, to the professional man and to the student, is indispensable.

Like Mr. Hay, I shall begin with white, the representative of light, which is regarded as produced by the reflection of the three primary colors simultaneously in their relative neutralizing proportions. Although there are eight kinds of whites, there is only one which is understood as a pure white. Its contrasting color is black, being opposite to it in the scale, but the arragement in which its effect is the most happy is with blue and orange. In the series it lies nearest to yellow, which may be adopted as its melodizing color. With nearly all colors, however, it harmonizes in conjunction and opposition, and to its properties in separating two discordant colors I have already referred. It does not agree so well as gray with red and orange, and with blue, violet, &c. it is harsh. It is to be preferred to gray with yellow and blue, also with red and green, red and yellow, orange and yellow, orange and green, and yellow and green. With very *light* primrose, yellow forms an agreeable arrangement. All colors brought in contact with pure white must be light and cool, amongst which gray and green may be employed, and intense or rich coloring must be avoided. A south light is the best for white, which, when it is the predominating color for a room lighted from the north, should be made of a cream color, so as to get rid of the cold reflection as far as possible.

French white is, properly speaking, the lightest shade of purple, and is seldom used in house painting, but Mr. Syme says that he has seen it made the prevailing color of a drawing-room in a country residence with good effect. It can only be introduced when all the other colors are light and cool in tone, as any quantity of intense or rich coloring completely subdues it.

Black, the representative of darkness, is regarded as produced by the absorption of the three primary colors, simultaneously in their relative neutralizing proportions. In the series it lies next to purple, which may be considered as its melodizing color. Its contrasting color is white, we may also add yellow, but it is most happy in combination with red and green, red and yellow, orange and yellow, orange and green, and yellow and green. By being associated with sombre colors, such as blue and violet, and with the lower tints of the bright colors, it may be often made to produce a very good effect. It is always happy when used with two bright colors, as orange, yellow, red, and bright green. As a separating color it is often to be preferred to white. It is not so good as gray in combination with orange and violet, green and blue, and green and violet. It is only in arrangements of a cool and sombre character that it can be used in large quantities, and it is recommended to be used always pure and transparent. The ancients

* The Laws of Harmonious Coloring. By D. R. Hay. London: W. S. Orr, 1838.

used it happily and in great profusion, in the monuments of the Egyptians, the vases of Greece and Italy, and the decorations of Pompeii and Herculaneum. We find it in combination with the brightest colors, often used as a separating color or as a contrast, and always with effect. Mr. Hay recommends great caution in the use of both white and black, for being at the top and bottom of the scale, they are very dangerous colors to manage. Where gorgeousness is the object, they must not be brought in.

Pure yellow, of the power of 3, which Mr. Hay calls yellow jasmine, or a deep lemon hue, is the lightest of the three primary colors, and the nearest to white. Its contrasting color is purple, and it forms a strong contrast to black. Its melodizing colors are orange and green, which are the secondaries it forms with red and blue. Its ternary is citron, and its quaternary is brown and marrone. Being the most powerful of the primary colors, it is most offensive to the eye when used extensively in a pure state. With red, orange, or green, it does very well in combination with black, and even with gray. In artificial light, yellow, it is well known, appears to be of less intensity, as is the case with all colors into the composition of which it enters.

Primrose, which is a very light yellow, forms a pleasing arrangement with pure white, being a light and cool color.

Red, of the power of 5, is, by Mr. Hay, represented to be of the most intense geranium color, and as difficult to be defined; it is the second of the primaries, a very warm color, and the most positive of all colors, pre-eminent among them. Its contrasting color is green. The secondaries with which it melodizes are its combinations with yellow, forming orange, and with blue, forming purple. Its tertiary is russet, and its quaternary is marrone and slate. With another bright color it forms a good arrangement with black, as it does also when combined with yellow. Being a warm color, it acts upon all colours brought in contact with it, or into which it enters, and must not be used on a large scale uncombined, requiring great skill in its use. It is heightened by artificial light. It is considered to be an excellent key color, and when so used, it is recommended that its contrasting color, green, should be neutralized by being brought down in tone towards olive.

The nearest hue of red towards yellow is scarlet, which is very brilliant, and requires much the same management as orange. It must never be used in large masses, except under very peculiar circumstances. Its contrasting color is a bluish green. The ancients used black with scarlet.

The nearest hue of red towards blue is crimson, one of the most gorgeous, at the same time most cool and mellow, and very useful as a key color. Its contrasting color is a citron green, and its melodizing colors a bluish green and reddish purple.

Pink is the next hue after crimson, and is very useful for heightening reds in cool toned arrangements.

Blue, of the power of 8, is the deepest of the primary colors, and the nearest in relation to shade. It is a cool color, acting upon colors used with it, and may be employed in masses with much less glare than either of the other primaries. Its contrasting color is orange. The secondaries with which it melodizes, are its combinations with yellow,

forming green, and with red, forming purple. With green, however, blue is very discordant, more so than any primary with its secondary. Its tertiary is olive, and its quaternaries slate and marrone. With orange it makes a good arrangement with white, and with green agrees with gray, and with violet it enters into composition with black. Black may be very advantageously used with it under many circumstances. White and blue are apt to appear raw in contrast. When used with green and olive, on account of the discord, blue requires the interposition of gray, or of some other neutral color, with olive a purply gray may be used. Blue is reckoned a good key color, where a refreshing appearance is desired; with artificial light, however, it is chilled.

We now come to the secondaries.

Orange is a compound of yellow 3 and red 5, being of the power of 8. It is one of the most brilliant colors there is, and the contrast to blue; it requires therefore to be used with a sparing hand, although it is reckoned a good key color. Olive also forms a contrast with it. It is the melodizing color to yellow and red, and is itself melodized by its tertiaries, citron, formed with green, and russet with purple. It is acted upon by artificial light much in the same way as yellow is. With blue it may be combined with white, and with red, yellow or green may be used with white or black. With more yellow the hues which orange forms, are gold, giraffe, &c. and it then requires for its contrast purplish blue.

Green is the coolest of the medium of the secondaries, and is composed of yellow 3 and blue 8, being of the power of 11. Its contrasting color is red, and also russet. Green melodizes with yellow and blue, and is itself melodized by the tertiaries, citron, formed with orange, and olive with purple. It is one of the worst colors under artificial light. With red, orange, or yellow it may be used in composition with black or white, but with blue or violet, gray is to be used. Being such a soft color, green may be used in quantity without fear. It requires great care when used with blue, and should be separated by a neutral tint.

Purple is one of the darkest colors, most nearly allied to black; it is of the power of 11, and is composed of yellow 3 and blue 8. Its contrasting color is yellow, and the tertiary, citron, which is much used with it. Purple melodizes red and blue, and is melodized by its tertiaries, russet formed with orange, and olive with green. It is a cool color, and it suffers much under artificial light, but next to green it may be used with the most freedom. With green or orange it may be used; with gray and with blue, black is to be used. With white its combinations are very raw.

Indigo is the first hue formed by blue on its union with red, and is a heavy color little used, except in woven fabrics.

Purple forms various hues, as lilac, &c. with which citron may be advantageously used.

Gray is a neutral colour, and enters with effect into many combinations, being the medium between light and shade. It is very useful in separating blue from green or olive. Its most happy combination is with red and orange, and with orange and violet, green and blue, and green and violet.

To proceed to the tertiary colors.

Citron is a tertiary color, in which yellow predominates: it is composed of orange 8, and green 11, being of the power of 19, or yellow 6, red 5, blue 8: its contrasting color is purple, and also slate: it melodizes with orange and green, and is melodized by the next series, brown formed with russet, and marrone with olive. Citron is greatly relieved and harmonized by olive. It is soft and pleasing to the eye, and is the lightest of the tertiaries, much used as a contrast amongst low hues of crimson and purple.

In russet, red predominates, being composed of orange 8, and purple 13, of the power of 21, or yellow 3, red 10, blue 8. Its contrasting color is green, and also marrone. It melodizes with orange and purple, and is melodized by the next series, brown, formed with russet, and slate with olive. This tertiary is of great use, and particularly with green.

Olive has blue for its predominant constituent, and is composed of green 11, and purple 13, being of the power of 24, or yellow 3, red 5, blue 16. Its contrasting color is orange, and also brown. It melodizes with green and purple, and is melodized by marrone formed with citron, and slate formed with russet. Olive has a great relation to shade, and is characterized by Hay as soft and unassuming, being of great use in all arrangements, whether cool or warm, being employed with the lower hues of warm-toned or brilliant composition. It must not be brought in contact with blue, but separated by gray.

The next rank is held by the quaternaries or semi-neutral hues. These are :—

Brown composed of citron and russet, of the power of 40, consisting of yellow 9, red 15, blue 16. Its contrasting color is olive. It is a most useful color in the low parts of warm-toned arrangements.

Marrone is composed of citron and olive, being of the power of 43, or yellow 9, red 10, blue 24. Its contrasting color is russet. This semi-neutral is most useful in woven fabrics. It is considered to be deep and clear, and although allied to red, may be used where there is a preponderance of cool-toned colors.

Slate is the deepest of the semi-neutrals, and is composed of russet and olive, being of the power of 45, or yellow 6, red 15, blue 24. Its contrasting color is citron, and it can only be used in cool-toned arrangements.

On increasing the Evaporating Power of Boilers. [Extracted from the Inventor's Advocate.]

At a recent meeting of the Polytechnic Society, at Liverpool, a communication was read by Mr. C. W. Williams on the above subject.

Mr. Williams, who was provided with a number of working models wherewith to illustrate his views, addressed the meeting in a very clear and scientific manner, developing a most interesting discovery of his own, which (already practically tested) will be extremely valuable as effecting a more rapid generation of steam, without increasing the size of the vessel, or the requirement of additional fuel. The question, he said, involved the improvement of our boilers by a very simple contri-

vance, whether as applied to land engines, or to the advancement of steam navigation. There were two leading considerations in the application of fuel, which were, unhappily, confounded: one the generation of heat; and the other, its application. The first appertained more peculiarly to chemical science; and the second, to mechanical appliance. The object in view was, to transmit the greatest possible amount of heat for the generation of steam, with a given quantity of fuel. Heat was imparted by two distinct media, namely, radiation and conduction. By radiation, heat was conveyed to bodies not placed in contact, as was evinced by placing the hand pretty close to the flame of a candle. By conduction, heat was conveyed by metal or other substances not consumable. In the heating of boilers, both modes were necessarily operative. In radiation, the heat evolved proceeded in direct lines, or radii, from the combustion to the boiler or other body exposed to it. If a thermometer were placed with the ball near the candle, the mercury would rise by radiation; but if placed immediately over the flame, the heat would be greater, but different in the mode; for in this case it was not fairly radiation, but a compound medium, radiation and the heated and ascending gas being combined. The speaker then exhibited the model of a boiler, with its tortuous flues, through which the several gases passed; and expressed his conviction that nine-tenths of the heat in marine and land engine boilers was immediately received from the furnace and flame bed, and not from the current of heated gases, which might be made available to the same end by an improved construction of boiler. The general opinion of parties working steam-engines was, that to increase the size of the furnace would add to the heating of the whole boiler; but this, he considered, was treating the boiler with great neglect, for the object could be accomplished without such increase of the furnace. The means of conducting heat to water in boilers had been much neglected, reliance being almost solely placed on increasing the heating surface of the flues. His plan was to insert a number of iron or copper pins through the plates of the boiler, one end of them projecting into the flue and the other into the water in the boiler. These pins, exposed at one end to the heat in the flue, acted as powerful conductors, through the boiler plates, of the heat into the water. Hitherto, the question of the mere surface of plate exposed to the flues had been alone considered; and the only remedy for defective generation of steam was conceived to be an increase of that surface. The conducting pins, however, were found to absorb the heat from the gases in their progress along the plates of the boiler, and greatly to hasten the generation of steam. A pin of half an inch in diameter, projecting three inches into the flue, gave a heating surface of $4\frac{1}{2}$ inches, and by its conducting power and interior projection that half inch gave as much heat as nine half inches on the outer surface of the plate. Air was a good conveyer, but a bad conductor of heat; for it carried most of it out of the chimney. His object was to arrest the heat in its progress, and give it out at the right place. The current of heat passing along the plates of the boiler rendered them only transverse conductors; but the heated pins were longitudinal conductors. He also showed several iron pins that had long been experimentally in use in the boiler of a steam vessel with great success. He had endeavored to ascertain the

proper lengths of which they should be, so as to remain as durable conductors of heat. One of seven inches in length had become slightly oxidized at the end. Another of four inches long, was so little affected, that the smallest mark of the hammer, which it originally bore, was distinctly visible. He therefore considered about four inches to be the proper length. He further illustrated his invention by three evaporating pans, one of them with pins projecting into the boiler and also into the flues, which he called double conductors; another with pins projecting into the flue only, called single conductors; and the third, a plain boiler, on the usual plan, without any such conductor. The first he had found the more powerful in producing speedy evaporation; though the second was scarcely inferior. The third, or plain boiler, was greatly behind either in evaporating power. A gas lamp was affixed at one end of the double conducting pan, containing 22 lbs. of water, and the evaporation appeared to be rapid. With 30 feet of gas the evaporation was as follows:—

	Evaporation.		Waste Heat.
Common Pan, - - -	4 lbs.	14 oz. - - - - -	406
Single Conductors, -	7	13 - - - -	320
Double " -	8	5 - - - -	285

Here we see the quantity evaporated is in an inverse ratio to the waste heat by the chimney. He had tried them often, with precisely the same results, so that there could be no error.

He then combated, in a clear and comprehensive manner, an opinion expressed by Dr. Fyfe, of Scotland, in a tract published by him, that anthracite was the best fuel or coal for engine boilers. That opinion was founded solely on the fact that anthracite contained the greatest quantity of fixed carbon, or, in other words, left the greatest residue of coke. He differed from the deduction of the doctor, with whom he had corresponded on the subject. That gentleman had begun at the wrong end; he should have considered not the fuel alone, but the vessel in which it was consumed. He (Dr. F.) had taken no means to ascertain the quantity of heat that escaped in the gases or by the chimney. He had set down the hydrogen and hydro-carbon gases at nought, because he had not had the power of consuming them by the common furnace and boiler. He (Mr. W.) felt certain that the Scotch and English coal was superior, if properly employed.

Mr. Williams's communication was listened to with great attention, and he was frequently greeted with bursts of applause. Shortly before he concluded, Mr. Durance, engineer of the Liverpool and Manchester railway, stated that he had tried the conductor pins on the lecturer's principle in the boiler of one of their stationary engines with great success. He had only 105 pins driven into the boiler, and the steam, which could not before be kept up, was now abundant.

The Chairman then invited discussion on the subject; and some doubts were expressed and questions put as to the advantages of the invention, all of which were ably replied to by Mr. Williams, and ended in the complimentary acknowledgment of all who demurred, and the concurrence of all who were present, that the invention constituted a valuable and immense practical improvement in the construction of engine boilers.

EXTRACTS FROM NEW WORKS.

HISTORICAL NOTICE OF ELECTRICAL DISCOVERY.

BY DIONYSIUS LARDNER, D. C. L. &C.

[Continued from p. 386.]

To this Galvani replied, by showing that, when a single metal was used to connect the nerves and muscles, the convulsions ensued, and that, therefore, the contact of dissimilar metals could not be the source of the electricity. Volta rejoined, that it was impossible to be assured of the perfect homogenity of the metal, and that any the least heterogeneous matter contained in it would be sufficient for his hypothesis. Also, that when a single metal was used, the convulsions were uncertain, and never produced, except in cases where the organs were in the highest state of excitability; whereas, on the contrary, they happened invariably, and were long continued, when the connection was made by two dissimilar metals.

Tenacious of the cherished theory to the last, Doctor Valli, a partisan of Galvani, confounded the advocates of the school of Pavia, by showing that, by merely bringing the muscles themselves into contact with the nerves, *without the intervention of any metal whatever*, the convulsions ensued. To this, the expiring effort of the Bolognese party, Volta readily and triumphantly replied, that the success of the experiments of Valli required two conditions; 1st, that the parts of the animal brought into contact should be as heterogeneous as possible; and, 2dly, the interposition of a third substance between these organs. This, so far from overturning the theory of Volta, only gave it increased generality, showing, as it did, that electricity was developed, not alone by the contact of two dissimilar *metals*, but also by the contact of dissimilar substances not metallic.

From this time, the partisans of animal electricity gradually diminished, and no effort worth recording to revive Galvani's theory was made. Meanwhile, the hypothesis of Volta was, as yet, regarded only as the conjecture of a powerful and sagacious mind, requiring nevertheless much more cogent and direct experimental verification. This experimental proof he soon supplied.

The first analogy which Volta produced in support of his *theory of contact*, was derived from the well-known experiment of Sulzer. If two pieces of dissimilar metal, such as lead and silver, be placed one above and the other below the tongue, no particular effect will be perceived so long as they are not in contact with each other, but if their outer edges be brought to touch each other a peculiar taste will be perceived. If the metals be applied in one order, the taste will be acidulous. If the order be inverted, it will be alkaline. Now, if the tongue be applied to the conductor of a common electrical machine, an acidulous or alkaline taste will be perceived, according as the conductor is electrified positively or negatively. Volta contended, therefore, that the identity of the cause should be inferred from the identity of the effects; that, as positive electricity produced an acid savor, and nega-

tive electricity an alkaline on the conductor of the machine, the same effects on the organs of taste produced by the metals ought to be ascribed to the same cause

However sufficient this analogy might seem to the understanding of Volta, it was insufficient for the rigid canons of the logic of modern physics, and he accordingly sought and obtained more direct and unequivocal proof of his hypothesis. Two discs, one of copper, and the other of zinc, were attached to insulating handles, by means of which they were carefully brought into contact, and suddenly separated without friction. They were then presented severally to a powerful condensing electroscope. The usual indications of electricity were obtained, and it was shown that this electricity was positive on the zinc, and negative on the copper. By repeating the contact, and collecting the electricity by means of the condenser, sparks were produced, and the demonstration was complete.

That the contact of dissimilar metals was followed by the evolution of electricity, could therefore no longer be doubted. It will, however, hereafter appear, that philosophers are not even yet agreed that the contact is the immediate or the only cause of the disengagement of electricity in such cases. Chemical agency is now known to be one of the sources of electricity, and its operation is so subtle, and often so imperceptible, and generally so inevitable, when heterogeneous molecules come into contact, that doubts have been entertained whether, in every case where electricity *seems* to proceed from contact, it has not really its origin in feeble and imperceptible chemical action.

Although the complete development of this last-mentioned idea belongs to a much more recent epoch in the progress of electrical discovery, yet the chemical origin of electricity did not altogether escape notice even at the period to which we now refer.

Of the numerous philosophers in every part of Europe who took part in the discussions, and varied and repeated the experiments connected with these questions, one of those to whom attention is more especially due was Fabroni, who, in the year 1792*, two years after the discovery of Galvani, communicated his researches to the Florentine Academy. In this paper is found the first suggestion of the chemical origin of galvanic electricity.

Fabroni observes that, in the neutral contact of heterogeneous metals, there is a reciprocal action which favors chemical change; that to this action must be ascribed many well-known phenomena, such as the more rapid oxidation of certain metals when combined, or in mere contact with other metals. According to him, a metal, like all chemical reagents, has a tendency to combination with another metal when they are brought into contact; that this effect is only prevented by the superior force of cohesion which prevails among the particles of each. This cohesive force will, however, be lessened in its energy by the antagonism of the attraction of the molecules of the two metals towards each other, just in the same manner as it would be lessened by the action of heat. Being thus lessened, its opposition to the tendency which the

* The date of the researches of this philosopher is generally, but erroneously, assigned to the year 1799.

particles of either metal have to combine with oxygen, taken either from the atmosphere, or obtained from the decomposition of water, would be proportionally diminished, and such oxidation would accordingly be promoted. In this way Fabroni accounts for the tendency of certain alloys of metal to oxidation, and for the well-known fact, that iron nails, then used in attaching the copper sheathing to vessels, were rendered so liable to rust by their contact with the copper, that they became soon too small for the holes in which they were inserted. He supposed, therefore, that, in the experiments of Galvani and Volta, in which the convulsions of the limbs of animals were produced, a chemical change was made by the contact of one of these metals with the liquid matter always found on the parts of the animal body, and that the immediate cause of the convulsions was not, as supposed by Galvani, due to animal electricity, nor, as assumed by Volta's hypothesis, to a current of electricity emanating from the surface of contact of the two metals; but to the decomposition of the fluid upon the animal substance, and the transition of oxygen from a state of combination with it to combination with the metal. The electricity produced in the experiments, Fabroni ascribed entirely to the chemical changes, it being then known that chemical processes were generally attended with sensible signs of electricity. He maintained that the convulsions were chiefly due to the chemical changes, and not to the electricity incidental to them, which, if it operated at all, he considered to do so in a secondary way.

The necessary limits of this notice will not allow of a further analysis of the researches of this philosopher; but if his original papers be referred to, it will be seen that he is entitled to the credit of having first distinctly demonstrated the chemical origin of voltaic electricity.

In the year 1800, the attention of the scientific world was withdrawn from the controversy respecting the origin of Galvanic electricity, and all other matters of minor importance, and engrossed by one of those vast discoveries which constitute an epoch in the progress of knowledge, and give a new direction to the sciences. On the 20th of March, 1800, Volta addressed a letter to Sir Joseph Banks, then president of the Royal Society in which he announced to him the discovery of the voltaic pile, one of the most powerful instruments for the investigation of the laws of nature, as exhibited in the mutual relations of the constituent parts of matter, which ever did honor to the science of any age, or any nation.

In order to complete the experimental analysis of the effects of galvanic electricity, Volta felt the necessity of collecting it in much greater quantities than could be obtained in the processes which had then been adopted. According to his theory, when two plates of metal, zinc and copper for example, were brought into contact, two currents of electric fluid originated at their common surface, and moved from that point in opposite directions. The positive fluid passed along the zinc, and the negative along the copper. If the extremities of the two metals most remote from their mutual contact were connected by an arc of conducting matter, these contrary currents would flow along this arc, the positive fluid moving from the zinc towards the copper, and the negative from the copper towards the zinc; but the intensity of these currents was supposed to be so feeble, that no ordinary electroscope, whatever

might be its sensibility, would be affected by it. In order to bring into operation in this question those instruments which had been applied to common electricity, he therefore sought some expedient by which he could combine, and, as it were, *superpose*, two or more currents, and thus multiply the intensity, until it should attain such an augmentation as to produce effects analogous to those which had been obtained by ordinary electricity.

With this object, he conceived the idea of placing alternately, one over the other, discs of different metals, such as zinc and copper. Let us suppose the lowest disc to be copper, having a disc of zinc upon it. On this disc of zinc, let a second copper disc be placed, and over that a second disc of zinc, and so on. According to Volta's theory, currents of electricity would be established at each surface of contact of the two metals, the positive current running along the zinc, and the negative along the copper. With the arrangement above described, there would proceed from the first surface, a negative downward, and a positive upward current; from the second a positive downward, and a negative upward current; from the third a negative downward and a positive upward current, and so on; the downward current being negative, and the upward positive from the upper surface of each copper disc, and the upper current being negative, and the downward positive from the lower surface of such disc. It is evident, therefore, that the downward currents would be alternately positive and negative; and the same would be the case with the upward currents. Now, since the surfaces of contact of the metals would be equal, these currents would have equal intensities, and accordingly each positive current would neutralize each negative current having the same direction. The result would be, that if the lowest and highest disc of the pile were of the same metal, all the currents neutralizing each other, the pile would evolve no electricity whatever; and if they were of different metals, all the downward currents, except one, would neutralize each other, and that one would be positive. The effect of the pile would therefore be the same as if it consisted of only two discs, one of copper, and the other of zinc.

Volta, therefore, saw the necessity of adopting some expedient by which all the currents in the same direction should be of the same kind; so that, for example, all the descending currents should be negative, and all the ascending currents positive. If this could be accomplished, the current issuing from the bottom of the pile would be a negative current as many times more intense than one proceeding from a single pair of discs as there were surfaces of contact supplying currents, and the same would be true of the positive current issuing from the top of the pile.

To effect this, it was necessary to destroy the galvanic action at all those surfaces from which descending positive and ascending negative currents would proceed; that is, the lower surfaces of the copper discs and the upper surfaces of the zinc discs. But while this was affected, it was also essential, that the progress of the descending negative and ascending positive currents should still be uninterrupted. The interposition of any substance which would of itself have no sensible galvanic action on either of the metals between each disc of copper and the disc of zinc immediately below it, would attain one of these ends, since the

action of all the surfaces in which ascending negative or descending positive currents could originate, would thus be prevented. But in order to allow the free progress of the remaining currents in each direction, such substance must be a sufficiently free conductor of electricity. Volta selected, as the fittest means of fulfilling these conditions, discs of wet cloth. They would be free from any sensible galvanic action on the metal, and their moisture would give them sufficient conducting power.

Having discovered the principles by which this species of electricity can be accumulated in quantity and strong currents obtained, he varied its form, and contrived the apparatus which is known by the name of *La Couronne de Tasses*. This arrangement, which Volta himself most most commonly used in his experiments, consisted of a row or circle of glasses or cups filled with warm water, or a solution of sea-salt. He immersed in each glass a plate of zinc and one of silver, not in contact, and then established a metallic communication by means of wire between the zinc of one glass and the silver of the adjacent one. The positive fluid was found to proceed from the extreme zinc plate, and the negative from the extreme silver one, and a continuous current was obtained by connecting these by any conductors of electricity.

Profoundly impressed with the importance of the results likely to arise from the application of the powers of the pile in physical inquiries, and doubtless animated by the desire for which he was honorably distinguished to extend all possible encouragement and advantage to those engaged in the natural sciences, Napoleon, then first consul, and surrounded by the splendor of his southern triumphs, invited Volta to visit Paris, and there, at the Institute, before the *élite* of European philosophers, to explain personally his great invention, and expound his views as to its probable uses and powers as an instrument of scientific research. Volta accepted the proffered honor, and, in 1801, attended at three meetings of the Academy of Sciences, at which he explained his theory of contact, and developed his views respecting the *voltaic*, or, as he called it, *electro-motive*, action of different metals upon each other. Among the audience at these memorable meetings was Napoleon himself, and none present appeared to appreciate more justly the vastness of the power which was on that occasion placed in the hands of the experimental philosopher.

When the report of the committee on the subject was read, the First Consul proposed that the rules of the Academy, which produced some delay in conferring its honors, be suspended, and that the gold medal be immediately awarded to Volta, as a testimony of the gratitude of the philosophers of France for his discovery. This proposition being carried by acclamation, the hero of an hundred fields, who never did things by halves, and who was filled with a prophetic enthusiasm as to the powers of the pile, ordered two thousand crowns to be sent to Volta the same day from the public treasury, to defray the expenses of his journey.* He also founded an annual medal, of the value of three thousand francs, for the best experiment on the electric fluid, and a prize of sixty thousand francs to him who should give electricity or magnetism,

* Arago, Eloge de Volta, p. 42.

by his researches, an impulse comparable to that which it received from the discoveries of Franklin and Volta.

The relation in which the voltaic pile stood in reference to the Leyden jar and electrical machines now began to be perceived. In the latter apparatus, a great quantity of electricity is accumulated on the surfaces of the jar, and held there in equilibrium, the positive fluid on one side of the glass, and the negative on the other. When the communication is made between the two surfaces, a torrent of the fluid precipitates itself instantaneously along the line of communication, and the electrical equilibrium is re-established in an interval of time so short as to be inappreciable. A sudden, instantaneous, and violent effect is produced on whatever bodies may be exposed to the transit of this electric fluid. On the other hand, the voltaic pile is a generator of electricity, which supplies to its opposite poles the two fluids, the positive and the negative electricity, in a continued, gentle, and regulated current. It discharges it not suddenly or instantaneously, or with uncontrollable and irresistible violence, but with gentle, moderate, continued, and regulated action. What takes place in the Leyden jar in an interval so brief as to render observation of its progress, or examination of its successive effects impossible, is with the pile spread over as long an interval as the observer may desire. Besides this, the effect themselves consequent on the two modes of action are different. That which in mechanical phenomena is effected by a violent blow or concussion, is not more different from the effects of the long-continued action of an uniform accelerating force or a constant pressure, than are the effects of the common electrical discharge from those of the currents of electricity propagated between the poles of the pile.

The physical effects of electricity exhibited under these different forms, differ in a manner which might be anticipated from these modifications in the transmission of the electric fluid. If the wires proceeding from the opposite poles, and conducting the contrary currents of fluid, be taken in the hands, the sudden and violent shock of the Leyden jar is no longer felt. It is replaced by a continued convulsion in the arms and shoulders, which does not cease so long as the wires are held.

If a metallic plate, in connection with the positive pole, be applied to the tongue, and another connected with the negative pole to any other part, a strong acidulous savor is perceived. If the plate applied to the tongue be connected with the negative pole, a strong alkaline savor is felt.

It is not the organs of taste only which are sensible to the influence of this instrument. The sense of sight is susceptible of its operation in a manner even more wonderful. Let a metallic surface connected with one of the poles be applied to the forehead, the cheek, the nose, the chin, or the throat; and, at the same time, let the patient take in his hand the wire connected with the other pole. Immediately a light will be perceived, even though the eyes be closed, the splendor and appearance of which will vary with the part of the face in contact with the metallic plate. By similar means, the perception of sound will be perceived in the ears.

The action of the pile on the animal body after the vital principle is destroyed is so well known, that it is scarcely necessary to mention it

here. The trunk of a decapitated body will rise from its recumbent posture; the arms will move and strike objects near them; the legs will elevate themselves with a force sufficient to raise considerable weights; the breast will heave as if respiration were restored; and, in fine, all the vital actions will be manifested with terrific and revolting precision.

In the hands of the entomologist, the pile affords results not less interesting. The glow-worm, submitted to the electric current, shines with increased splendor; the grasshopper chirps, as if under the action of a stimulant.*

The physiological action of the pile was strongly suggestive of a mysterious connection between the electric fluid and the proximate principle of vitality. When some of these effects were exhibited to Napoleon, the emperor turned to Corvisart, his physician, and said, "Docteur, voilà l'image de la vie: la colonne vertébrale est la pile; le foie, le pôle negatif; la vessie, le pôle positif."†

The invention of the pile had been scarcely more than hinted at, when that course of electro-chemical investigations began which soon led to the magnificent discoveries of Davy, and the series of experimental researches which have been continued to the present time with results so remarkable by those who succeeded him. The first four pages only of the letter of Volta to Sir Joseph Banks were dispatched on the 20th of March, 1800; and as these were not produced in public till the receipt of the remainder, the letter was not read at the Royal Society, or published until the 26th of June following. The first portion of the letter, in which was described generally the formation of the pile, was shown in the latter end of April by Sir Joseph Banks to some scientific men, and among others to Sir Anthony (then Mr.) Carlisle, who was engaged at the time in certain physiological inquiries. Mr. W. Nicholson, the conductor of the scientific journal known as *Nicholson's Journal*, and Carlisle constructed a pile of seventeen silver half-crown pieces alternated with equal discs of copper and cloth soaked in a weak solution of common salt, with which on the 30th of April they commenced their experiments. It happened that a drop of water was used to make good the contact of the conducting wire with a plate to which the electricity was to be transmitted; Carlisle observed a disengagement of gas in this water, and Nicholson recognized the odor of hydrogen proceeding from it. In order to observe this effect with more advantage, a small glass tube, open at both ends, was stopped at one end by a

* Eloge. p. 33.

† This anecdote was told by Chaptal, who was present on the occasion, to Bequerel; and the latter relates it in the first volume of his work on electricity, published in 1834. The idea that electricity is the immediate principle of vitality has occurred to other minds. Sir John Herschel, in his Preliminary Discourse published in the Cabinet Cyclopædia in 1830, without any knowledge of the above anecdote, says (p. 343.), "If the brain be an electric pile constantly in action, it may be conceived to discharge itself at regular intervals, when the tension of the electricity developed reaches a certain point, along the nerves which communicate with the heart, and thus to excite the pulsation of that organ. This idea is forcibly suggested by the view of that elegant apparatus, the dry pile of De Luc, in which the successive accumulations of electricity are carried off by a suspended ball, which is kept by the discharge in a state of regular pulsation for any length of time." A similar idea occurred to Dr. Arnott, and is mentioned in his Physics.

cork, and being then filled with water was similarly stopped at the other end. Through both corks pieces of brass wire were inserted, the points of which were adjusted at a distance of an inch and three quarters asunder in the water. When these wires were put in communication with the opposite ends of the pile, bubbles of gas were evolved from the point of the negative wire, and the end of the positive wire became tarnished. The gas evolved appeared on examination to be hydrogen, and the tarnish was found to proceed from the oxidation of the positive wire. It was inferred that the process in which these effects were produced was the decomposition of water. This took place on the 2d of May, shortly after the receipt of the first portion of Volta's letter.

To ascertain whether the oxidation of the positive wire was an effect incidental to the experiment, or had an influence in producing the decomposition, Nicholson determined to try the effect of wires formed of metal more difficult of oxidation. Wires of platinum were accordingly inserted through the corks, and the experiment repeated. Bubbles of gas were now evolved from both wires. Two platinum wires were next inserted at the closed ends of two separate tubes, which, being open at the other ends and filled with water, were inserted in the same vessel of water. Being placed side by side close together, and the wires being continued to the lower ends of the tubes, so that the distance between their points was not more than two inches, their upper extremities were put in connection with the ends of the pile. Gas was evolved from the points of both wires, and, ascending through the water, was collected separately in the two tubes. These gases being examined, proved to be hydrogen from the negative, and oxygen from the positive wire, nearly in the proportion known to constitute water.*

Thus was the decomposing power of the pile established within a few weeks after the first intimation of the invention of that instrument had been received in England, and before any description of it had been published. It seemed proper to give these details here, not only on account of the great importance of the discovery, but because it has been sought to depreciate the merit of it by ascribing it altogether to chance. It is probably impossible to exclude chance altogether from such investigations, but in this there was as little as is generally found.

When these experiments became known, Mr. W. Cruickshank of Woolwich repeated them, and obtained similar results; but observed, that when the distilled water was tinged with litmus, the effects of an acid were produced at the positive and those of an alkali at the negative wire. Led by this indication, he tried the effects of the wires on solutions of acetate of lead, sulphate of copper, and nitrate of silver. In each case he found the metallic base deposited at the negative pole, and the acid manifested at the positive pole. Muriate of ammonia and nitrate of magnesia were next decomposed, the acid as before going to the positive, and the alkali to the negative pole. These experiments of Mr. Cruickshank were made as early as June, 1800.†

In the September following, Mr. Cruickshank published the con-

* Nicholson's Journal, vol. iv. p. 179. 1800. † Ibid. p. 187. 1800.

tinuation of his researches,* in which he corroborated the results of his former experiments, showing more generally the tendency of oxygen and the acids in voltaic decomposition to collect round the positive wire, and hydrogen, metals, alkalies, &c. round the negative pole.

The investigations of which the pile became the instrument, now began to assume an importance which rendered it necessary to give it considerably augmented power, either by increasing its height or enlarging its component plates. In either case, inconveniences were encountered which imposed a practical limit on the increase of its power. When the number or magnitude of the metallic discs was considerable, the incumbent pressure discharged the liquid from the intermediate discs of cloth or card. The trouble of refilling it whenever its use was required, and of wetting the cloth or card, was very great. Mr. Cruickshank, adopting the principle of Volta's *couronne des tasses*, proposed, as a more convenient form for the apparatus, an arrangement consisting of a trough of baked wood, which is a non-conductor of electricity, divided by parallel partitions into a series of cells. Into these cells the liquid to be interposed between the successive pairs of metallic plates was poured. A series of rectangular plates of metal, alternately zinc and copper, was arranged, so as to be parallel to each other, and at such a distance as to allow the partitions of the trough to pass between each pair of plates. This modification rendered the voltaic apparatus capable of having its power increased without practical limit.

While these investigations were proceeding, Ritter, afterwards so distinguished for his experimental researches, but then young and unknown, made various experiments at Jena on the effects of the pile; and apparently without knowing what had been done in England, discovered its property of decomposing water and saline compounds, and of collecting oxygen and the acids at the positive, and hydrogen and the bases at the negative pole. He also showed that the decomposing power in the case of water could be transmitted through sulphuric acid, the oxygen being evolved from a portion of water on one side of the acid, while the hydrogen was produced from another separate portion of water on the other side of it.†

When the chemical powers of the pile became known in England, Sir Humphrey (then Mr.) Davy was commencing those labors in chemical science which subsequently surrounded his name with so much lustre, and left traces of his genius in the history of scientific discovery which must remain as long as the knowledge of the laws of nature is valued by mankind. The circumstance attending the decompositions effected between the poles of the pile which caused the greatest surprise was the production of one element of the compound at one pole, and the other element at the other pole, without any discoverable transfer of either of the disengaged elements between the wires. If the decomposition was conceived to take place at the positive wire, the constituent appearing at the negative wire must be presumed to travel through the fluid in the separated state from the positive to the negative point; and if it was conceived to take place at the negative wire, a similar transfer must be imagined in the opposite direction. Thus, if

* Ibid, p. 254.

† Ibid, p. 511.

water be decomposed, and the decomposition be conceived to proceed at the positive wire where the oxygen is visibly evolved, the hydrogen from which that oxygen is separated must be supposed to travel through the water to the negative wire, and only to become visible when it meets the point of that wire; and if, on the other hand, the decomposition be imagined to take place at the negative wire where the hydrogen is visibly evolved, the oxygen must be supposed to pass invisibly through the water to the point of the positive wire, and there become visible. But what appeared still more unaccountable was, that in the experiment of Ritter it would seem that one or other of the elements of the water must have passed through the intervening sulphuric acid. So impossible did such an invisible transfer appear to Ritter, that at that time he regarded his experiment as proving that one portion of the water acted on was wholly converted into oxygen, and the other portion into hydrogen.*

This point was the first to attract the attention of Davy, and it occurred to him to try if decomposition could be produced in quantities of water contained in separate vessels united by a conducting substance, placing the positive wire in one vessel and the negative in the other. For this purpose, the positive and negative wires were immersed in two separate glasses of pure water. So long as the glasses remained unconnected, no effect was produced; but when Davy put a finger of the right hand in one glass and of the left hand in the other, decomposition was immediately manifested. The same experiment was afterwards repeated, making the communication between the two glasses by a chain of three persons. If any material principle passed between the wires in these cases, it must have been transmitted through the bodies of the persons forming the line of communication between the glasses.

The use of the living animal body as a line of communication being inconvenient where experiments of long continuance were desired, Davy substituted fresh muscular animal fibre, the conducting power of which, though inferior to that of the living animal, was sufficient. When the two glasses were connected by this substance, decomposition accordingly went on as before, but more slowly.

To ascertain whether metallic communication between the liquid decomposed and the pile was essential, he now placed lines of muscular fibre between the ends of the pile and the glasses of water respectively, and at the same time connected the two glasses with each other by means of a metallic wire. He was surprised to find oxygen evolved in the *negative*, and hydrogen in the *positive* glass, contrary to what had occurred when the pile was connected with the glasses by wires. In none of these cases did he observe the disengagement of gas either from the muscular fibre or from the living hand immersed in the water.

In October, 1800, after many experiments on the chemical effects of the pile, Davy commenced an investigation of the relation which its power had to the chemical action of the liquid conductor on the more oxidable of its metallic elements. The influence of chemical decomposition in evolving the voltaic electricity originally maintained by Fabroni, was again brought under inquiry by Col. Haldane. Davy showed that

* Ibid, p. 512.

at common temperatures zinc, connected with silver, suffers no oxidation in water which is well purged of air and free from acids, and that with such water as a liquid conductor, the pile is incapable of evolving any quantity of electricity which can be rendered sensible either by the shock or by the decomposition of water; but that if the water used as a liquid conductor hold in combination oxygen or acid, then oxidation of the zinc takes place, and electricity is sensibly evolved. In fine, he concluded that the power of the pile appeared to be, in great measure, proportional to the power of the liquid between the plates to oxidate the zinc.*

He inferred from these results, that although the exact mode of operation could not be accounted for, the oxidation of the zinc in the pile, and the chemical changes connected with it, were *somehow the cause of its electrical effects.*

To ascertain whether a liquid solution capable of conducting the electric current between the positive and negative wires of a voltaic pile, but not capable of producing any chemical action on its metallic elements, would, when used between its plates, evolve electricity, Davy constructed a pile in which the liquid was a solution of sulphuret of strontia. When the current from an active pile was transmitted through the liquid, the shock was as sensible as if the communication had been made through water; but, on the other hand, solutions of the sulphurets were incapable of acting chemically on the zinc. If, therefore, chemical action on the zinc be a necessary condition to insure the activity of the pile, such an arrangement must be inactive. Twenty-five pairs of silver and zinc plates, erected with cloths moistened in solution of sulphuret of strontia, produced no sensible action, though the moment the sides of the pile were moistened with nitrous acid, the ends gave shocks as powerful as those of a similar pile constructed in the usual manner.

The next question brought to the test of experiment was, whether the chemical action which takes place between the liquid and the plates of the pile is of the same kind as that which is manifested when water is decomposed by its extreme wires; that is, whether, when the oxygen is freed upon the surface of the zinc, the remaining constituent of the solution decomposed is also liberated at the surface of the zinc, as in ordinary oxidation, or is transmitted invisibly through the fluid to the surface of the silver, and there deposited, or otherwise liberated, as in the decomposition between the positive and negative wires. An arrangement of zinc and copper plates, in the form of the *couronne des tasses*, was formed, and charged with spring water. The general result of these experiments showed that the hydrogen, combined with the zinc, was manifested not at the zinc, but at the silver surface; and therefore, that the action in the cells is similar to the decomposition of water at the extreme wires of the pile. The phenomena were, however, rendered less decisive of the question by the modifications produced by the azote of the common air combined with the water, and also by saline matter which it held in solution, effects which were then imperfectly understood.

The inventor of the pile maintained, that among the metals, those

* Ibid, p. 337.

which held the extreme places in the scale of electro-motive power were silver and zinc, and that, consequently, these metals, paired in a pile, would be more powerful, *cæteris paribus*, than any other. But as he also showed that pure charcoal was a good conductor of the electric current, and that the electro-motive virtue depended on the different conducting powers of the metallic elements, it was consistent with analogy that charcoal, combined with another substance of different conducting power, would produce voltaic action. Dr. Wells accordingly showed that a combination of charcoal and zinc produced sensible convulsions in the frog; and Davy, adopting this principle, constructed a *couronne des tasses*, consisting of a series of eight glasses, with small pieces of well-burned charcoal connected with zinc by pieces of silver wire, using a solution of red sulphate of iron as the liquid conductor. This series gave sensible shocks, and rapidly decomposed water. Compared with an equal and similar series of silver and zinc, its effects were much stronger. Hence he inferred that charcoal and zinc formed a combination equal, if not superior, to any of the metals.

Volta was understood to refer the electro-motive power of the metallic elements of the pile to the difference of their powers as conductors of electricity. The experiments of Davy induced him to connect the electro-motive power with the amount of chemical action on the more oxidable metal. These two principles might, nevertheless, be compatible, if it could be shown that the oxidation was dependent on, and proportional to, the difference of conducting power of the metals. To test this, it was only necessary to construct a pile with metals of nearly equal conducting power. With this view, Davy constructed a pile with gold and silver plates, these metals being supposed to differ very little in their power of conducting electricity, interposing discs of cloth moistened with dilute nitric acid. Voltaic action was produced. A similar pile, formed of plates of silver and copper, and a solution of nitrate of mercury, acted powerfully. The conducting powers of these several metals were then considered as nearly equal.*

In considering the various arrangements and combinations in which voltaic action had been manifested, Davy observed, as a common character, that, in every case, one of the two metallic elements was oxidated, and the other not. Did not the production of the electric current, then, depend merely on the presence of two metallic surfaces, one undergoing oxidation, separated by a conductor of electricity; and if so, might not a voltaic arrangement be made by one metal only, if its opposite surfaces were placed in contact with two different liquids; one of which would oxidate it, and the other transmit electricity without producing oxidation? To reduce this to the test of experiment with a single metallic plate would have been easy; but in constituting a series or pile, the two liquids, the oxidating and the non-oxidating, must be in contact, and subject to intermixture. To overcome this difficulty, different expedients were resorted to, with more or less success; but the most convenient and effectual method of attaining the desired end was suggested to Davy by count Rumford. Let an oblong trough be formed, similar to that suggested by Cruickshank, as a substitute for the pile, and let

* The relative conducting power of the metals has not even yet been satisfactorily established.

grooves be made in it such as to allow of the insertion of a number of plates, by which the trough may be divided into a series of water-tight cells. Let plates of the metal of which the apparatus is to be constructed be made to fit these grooves, and let as many plates of glass or other non-conducting material, of the same form and magnitude, be provided. Let the metallic plates be inserted in alternate grooves of the trough, and the glass plates in the intermediate grooves, so as to divide the trough into a succession of separate cells, each cell having on one side metal, and on the other glass. Let such an arrangement be represented in Fig. 1, where the metallic plates are represented at M, the intermediate plates being glass. Let the alternate cells O be filled with the oxidating liquid, and the intermediate cells L with the liquid which conducts without oxidating. Let slips of moistened cloth be hung over the edge of each of the glass tubes, so that its ends shall dip into the liquids in the adjacent cells. This cloth, or rather the liquid it imbibes, will conduct the electric current from cell to cell, without permitting the intermixture of the liquids.

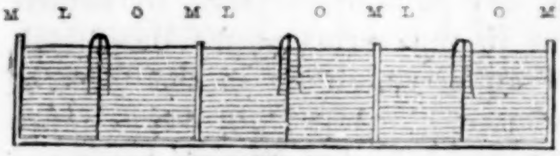


Fig. 1.

In the first arrangements made on this principle, the most oxidable metals, such as zinc, tin, and some others, were tried. The oxidating liquid O was dilute nitric acid, and the liquid L was water. In a combination consisting of twenty plates of metal, sensible but weak effects were produced on the organs of sense, and water was decomposed slowly by wires from the extremities. The wire from the end towards which the oxidating surfaces were directed evolved hydrogen, and the other oxygen.

To determine whether the evolution of the electric current was dependent on the production of oxidation, or would attend other chemical effects producible by the action of substances in solution upon metal, the oxidating liquid was now replaced by solutions of the sulphurets, and metallic plates were selected on which these solutions would exert a chemical action. Silver, copper, and lead were tried in this way. Solution of sulphuret of potash was used in the cells O, and pure water in L. A series of eight metallic plates produced sensible effects. Copper was the most active of the metals tried, and lead the least so. In these cases, the terminal wires produced, in the usual manner, the decomposition of water, the wire from which hydrogen was evolved being that which was connected with the end of the series to which the surfaces of the metal not chemically acted on were presented.

It will be observed that in this case the direction of the electric current relatively to the surfaces of the metallic plates was the reverse of the former. When oxidation was produced, the oxidating sides of the plates looked towards the negative end of the series. Comparing these two effects, Davy was led by analogy to suspect that if the cells O were filled with an oxidating solution, while the cells L were filled with a solution of sulphuret, or any other which would produce a like chemical action, the combined effect of the currents proceeding from the two distinct chemical processes would be obtained. This was ac-

cordingly tried, and the results were as foreseen. The acid solution was placed in the cells O, and the sulphuret in the cells L. A series, consisting of three plates of copper or silver, arranged in this way, produced sensible effects; and twelve or thirteen decomposed water rapidly. The oxidating sides of the metal looked to the negative end of the series.

As it appeared from former experiments that charcoal possessed, as a voltaic agent, the same properties as the metals, the next step in this course of experiments was naturally to try whether a voltaic arrangement could not be constructed without any metallic element, by substituting charcoal for the metallic plates in the series above described. This was accomplished by means of an arrangement in the form of the *couronne des tasses*. Pieces of charcoal, made from very dense wood, were formed into arcs; and the liquids O and L were arranged in alternate glasses, as represented in Fig. 2. The charcoal arcs C were placed so as to have one end immersed in each liquid, the intermediate glasses being connected by slips of bibulous paper P. When the liquid O was dilute acid, and L water, a series consisting of twenty pieces of charcoal gave sensible shocks, and decomposed water. This arrangement also acted, and with increased intensity, when the liquid O was sulphuric acid, and L was solution of sulphuret of potash.

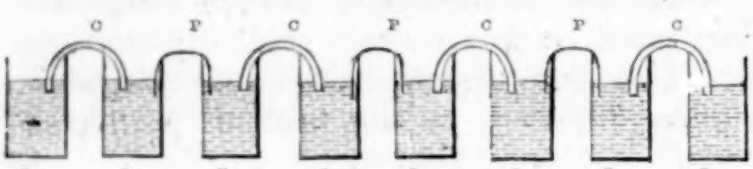


Fig. 2.

The connection of chemical change with the production of electricity in the pile, was too obvious not to attract the attention of other philosophers. Pepys in England, and MM. Biot and Frederic Cuvier in France, investigated the effect produced by the pile on the atmosphere in which it was placed. The former placed the pile in an atmosphere of oxygen, and found that in the course of a night 200 cubic inches of the gas had been absorbed. In an atmosphere of azote the pile had no action. MM. Biot and Cuvier also observed the quantity of oxygen absorbed, and inferred from their experiments that "although, strictly speaking, the evolution of electricity in the pile was produced by oxidation, the share which this had in producing the effects of the instrument bore no comparison with that which was due to the contact of the metals, the extremity of the series being in communication with the ground."

Dr. Wollaston and Gautherot, on the other hand, reproduced the principle advanced by Fabroni and Crève. Wollaston maintained that chemical action was not only the source of the electricity of the pile, but also of the common electrical machine. He showed that by conveying the electricity of the machine to gold wires terminated in extremely fine points the decomposition of water could be effected, and that the phenomenon was the same as when the decomposition was effected by voltaic wires. He maintained that the friction of the rubber was attended with oxidation, and showed that the machine was ineffective in an atmosphere of dry hydrogen, or any other gas in which chemical action was not produced.

If an oblong slip of wet paper have its extremities in contact with the poles of a voltaic pile, each half of the slip will be electrified; that which is in contact with the positive pole will be positively electrified, and that which is in contact with the negative pole will be negatively electrified. If it be removed from contact with the pile by a rod of glass, or other non-conductor, its electric state will continue. This means of producing electrical polarity was observed by Volta, and about the same time by Erhman.

This fact suggested to Ritter the idea of his *secondary pile*, which consisted of a series of discs of a single metal alternated with cloth or card, moistened in a liquid by which the metal would not be affected chemically. If such a pile have its extremities put in connection by conducting substances with the poles of an insulated voltaic pile, it will receive a charge of electricity in a manner similar to the band of wet paper, one half taking a positive and the other a negative charge; and after its connection with the primary pile has been broken, it will retain the charge it has thus received. The secondary pile while it retains its charge, produces the same physiological and chemical effects as the voltaic apparatus.

The polarity which the band of wet paper and the secondary pile acquire by their temporary contact with the ends of a voltaic apparatus, is a consequence of their imperfect conducting power. The electricity of each species appears to force its way through the imperfect conductor till the two opposite currents meet in the centre.

At the time of the discovery of the secondary piles, it was known that a piece of metallic wire, the ends of which had been placed in contact with the poles of a voltaic pile, does not instantly recover its natural state when its contact with the pile is broken.

From the experiments of Davy and others, it appeared that if a communication was made between the poles of an insulated pile and two glasses of water, so that the water in the one would be charged with positive, and the other with negative electricity, a metallic wire connecting the two portions of water would evolve oxygen gas at one point, and hydrogen at the other. If, under such circumstances, the connection of the glasses with the pile be suddenly broken, the action of the wire will nevertheless continue for some time, but its effects will be reversed; the point which before disengaged hydrogen will now disengage oxygen, and *vice versâ*. It appears, therefore, that the sudden suspension of the action of the pile has the effect of reversing the direction of the electric current which passes through the wire.*

The continuance of the electric state of a wire which had been used to connect the poles of a pile after its separation from the pile was also demonstrated by Oersted, who showed its effect on the organs of a frog.† The same effect was produced by a wire through which the current of a powerful electrical machine had been transmitted.

From the chemical effects of the pile, Davy turned his attention to its calorific powers. The means of experimental investigation placed at his disposal were enlarged by the apparatus of the laboratory of the

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* Histoire de Galvanism de Sue, tom. iii. p. 341. † Journ. de Opin. de Van Mons, No. iv. p. 68.

Royal Institution, which was now under his direction. The voltaic apparatus consisted of a series of 150 pairs of four-inch plates of zinc and copper, and a series of 50 pairs of zinc and silver of the same magnitude. The plates were cemented into four troughs of wood, according to the method proposed by Cruickshank. Another apparatus was provided, consisting of a series of twenty pairs of thirteen-inch plates of zinc and copper.

With the batteries of the smaller plates he repeated some of the experiments on the production of the spark, and the combustion of the metals which had already been made. When the poles consisted of two knobs of brass, the spark which attended the discharge was of dazzling brightness, and one eighth of an inch in apparent diameter. Between pieces of charcoal it had a vivid whiteness, and the charcoal remained red hot for some time after the contact was broken, and threw off bright coruscations. The current passing through steel wire $\frac{1}{170}$th of an inch in diameter, rendered it white hot, and caused it to burn with great splendor. Gold, silver, copper, tin, lead, and zinc were also burnt. Platinum in thin slips was rendered white hot and fused.

Fourcroy, Vauquelin, and Thénard had investigated the different effects produced by enlarging the plates of a battery, and by increasing their number. They demonstrated that the power of the apparatus to heat and ignite metallic substances was augmented by enlarging the plates, without increasing their number; but that no increase of power to decompose water, or to produce the shock, ensued. The calorific power, therefore, appeared to depend, *cæteris paribus*, on the magnitude of the plates, while the chemical and physiological power depended on their number.

The battery of thirteen-inch plates was tried successively with pure water, a solution of common salt, and dilute nitric acid. With water its effects were feeble, with the solution of salt they were much more considerable, and were still more energetic with nitric acid. With the last three inches of iron wire, $\frac{1}{170}$th of an inch in diameter, were rendered white hot, and two inches of the same wire were fused. The action of the water, feeble as it was, was ascribed to the air and saline matter it held in solution; and it was judged from analogy that water perfectly purged of air, and free from all saline substances, would have no voltaic action. A pile of thirty-six pairs of five-inch plates lost its activity in an atmosphere of azote and hydrogen in about two days; and its power was constantly restored by common air, and rendered more intense by oxygen gas.

When two pieces of well-burnt charcoal, or a piece of charcoal and a metallic wire, are connected with the apparatus and immersed in water, on completing the circuit, gas was abundantly evolved, and the points of the charcoal appeared red hot for some time after the contact was made. Sparks were also produced by means of charcoal points immersed in concentrated nitric and sulphuric acids. When two charcoal points acted in water, the gaseous products consisted of one eighth carbonic acid, one eighth oxygen, and one eighth inflammable gas, apparently hydrogen. The gases produced by a similar process from alcohol, ether, and dilute sulphuric acid, were also a mixture of oxygen and hydrogen. In all these cases it appeared that the gases proceeded

chiefly from the decomposition of the water contained in the several solutions.

The effects of the ignition of charcoal in muriatic acid confined over mercury were next tried. The charcoal being kept white hot for nearly two hours, the gas was very little reduced in volume, and the charcoal was not sensibly consumed. When the gas was examined, three fourths of it were absorbed by water, and the remainder was inflammable.*

(TO BE CONTINUED.)

MISCELLANEOUS.

Wire Bridge at Fairmount.—This novel, yet beautiful structure, is going ahead rapidly, and will be ready for use early in the spring. The bridge itself will be composed of wood, suspended from wire cables. Ten cables, consisting of about 300 wires each, are stretched from the abutments on each side of the river. They pass over the tops of massive granite columns 30 feet high. These columns stand on the tops of the abutments, and the cables are secured on the eastern side in the solid rock, and on the western side by huge blocks of granite above the excavations. The cables, as they pass the tops of the columns, rest upon the iron axles, which yield a little as the action of the bridge needs relief.

The distance from the granite columns to the centre of the span of the inverted arch formed by the cables, is about 350 feet. The curves of course will be very beautiful. The bridge itself runs in a horizontal line, from abutment to abutment, cutting the curve at its base. It will be 26 feet wide, afford ample space for the carriage way, and footpaths on each side of generous width. The bridge is simply a platform with railings, made light and graceful. It will hang from the cables by wire ropes, securely fastened. The whole structure will combine beauty, strength, durability, for freshets can never reach it, and the cables are incapable of decay. Repairs upon the wood work can always be made with the utmost ease. Philadelphia American.

Remarkable fact in Mechanical Science—Absorption of Gold by Copper in a solid state.—The following curious facts in mechanical science, were recently discovered at the armory in Springfield, under the direction of Mr. Ames. We have the story from a mathematical student at Cambridge:

The facts, as I stated to you, were very curious. A workman was employed in gilding a copper sword scabbard, and had placed ten dollars worth of gold upon it, and was heating it. Suddenly, long before the copper had arrived at a melting point, the gold disappeared. Probably the gold was mixed with quicksilver, as is usual in such processes. At any rate the gold was gone, and the man thought it had evaporated with the quicksilver.

* Davy's Works, vol. ii. p. 214. London, 1839.

He went at once and told Mr. Ames the circumstance, but he thought it impossible that it could be so. Mr. Ames then took the copper and digested it, (a process employed to separate mixed metals,) and sure enough he obtained the full value of the gold from it. His curiosity being awakened, he then took a piece of copper, and put some gold upon it, heated it to a certain point and presto, the gold was gone! He put some more on, raised the temperature a little, and that went too.

He then sawed the copper in two, burnished the edges, examined it with a microscope, and found the gold lying in a body, just beneath the surface of the copper. The absorption of the gold is supposed to have taken place, owing to some change among the particles of the copper, which drew the gold in. This opinion is strengthened by other facts, which seem to show that such a change may take place in the particles of a metal not in a state of fusion. For instance, in the process of tempering, swords often get bent. Now if they are straightened while cold, they are found to lose their temper somewhat in the spot where they were bent; but if heated moderately, to a degree far below redness—and then straightened, while at that temperature, they retain their full temper. Besides, if the bent spot is gilded before heating, on heating and straightening it, the gilding disappears. Boston Daily Mail.

Improvements in Tanning.—This invention consists, firstly, in using the carbonates of potash or soda, dissolved in water, in the proportions of from one to two pounds of the carbonate to 10 gallons of water, for soaking or preparing hides or skins for unhairing.

Secondly.—In improvements in preparing hides or skins for unhairing, and at the same time swelling them, or for swelling them only, by the use of various agents, which are divided into three classes, viz., first class, baryta, potass, and soda; second class, muriatic, nitric, oxalic, and all other acids, except sulphuric acid; third class, vegetable matters, such as culinary rhubarb, sorrel, vine cuttings, &c. The agents which are preferred to be used are as follows:—Of the first class, soda dissolved in water, in the proportion of from half a pound to a pound of the dry carbonate to 10 gallons of water, being rendered caustic by half its weight of fresh burnt lime. Of the second class, muriatic acid diluted with water, in the proportion of from half a pound to two pounds of the acid of specific gravity 1.17 to 10 gallons of water. Of the third class, culinary rhubarb bruised and mixed with water, in the proportions of from one to ten pounds of the rhubarb to one gallon of water.

Thirdly.—In the use of the carbonates of ammonia, in the proportions of from half a pound to four pounds of them to 10 gallons of water, in the operation of graining hides and skins.

Fourthly.—In mixing vegetable matters and chemical agents capable of retarding oxidation with the tanning agent employed in small proportions. The vegetable matters, consisting of culinary rhubarb bruised, bruised potatoes, &c., the chemical agents of gum, starch, certain compounds of sulphur, &c.

Fifthly.—In the use of bichromate of potash in solution, in the proportions of from one eighth to half a pound of the bichromate to 100 gallons of water; or of sulphuric acid diluted with water, in proportions of from a quarter of a pound to a pound of the acid to 10 gallons of

water, for the preservation of animal matters, so as to prevent putrefaction.

The skins or other animal substances in their moist state are immersed in either of these solutions, and are kept from the dust. Inventors' Advocate.

The Cochineal Insect.—It is now just 45 years since this valuable commodity was conveyed into our East Indian territories, by an enterprising individual, an officer in the Madras army. Thirty years ago the Spaniards regarded this insect as being invaluable to them, producing a revenue to Spain larger than that afforded by their gold mines, although they were both derived from the self-same source—the state of Mexico. It was the desire of the Hon. East India Company to introduce the cochineal into their territories at the above period, and large rewards were held out to speculating adventurers to tempt and encourage them to colonize the insect on their various estates. But they could not succeed in their new undertaking. It has now, and particularly within the last 2 or 3 years, spread itself over the face of the whole of the Indian peninsula that falls within 42 degrees of north latitude, and has destroyed almost every cactus shrub (the prickly pear) upon which plant it wholly subsists. It may be deemed somewhat remarkable, when the great value of the cochineal insect is considered, that the natives have never encouraged it as a feature of commerce. Certain European adventurers have, however, within the last five years, endeavored to turn the insect to a good account; but they have all of them signally failed in producing cured samples of any size, so as to wear a favorable complexion in the London market, when placed in juxtaposition with the "grana fina" of Mexico and Oaxaca, and as none of the parties had had an opportunity of witnessing the mode in which the "nopaleries" in South America were managed, they were quite at a loss how to treat the insect. Some conjectured that the fly was a wild species of the "coccus coccinelifer;" whilst others considered it was the wrong plant upon which it was reared in India; and on the other hand, it was decided that the climate was uncongenial to the prosperity of the insect, which although it proved highly prolific, yet never arrived at any size. The Indian cochineal yields a stronger dye than that of New Spain, and is in every way calculated to prove a truly valuable article of commerce if it could be brought to a size equal to that of the insect of New Spain. A gentleman living on the Coromandel coast, a short time since, fed a small colony of these insects upon the "cactus inermis," a species of the "cactus opentia," perfectly free from thorns, and which it is said the South American coccus exclusively feeds upon, but it quickly perished under the bite of the insect, although the animalculae were not usually numerous; and he was led to imagine that the large "acicular" thorns which protrude from the lobes of the prickly pear (for the leaves are truly lobate) would, if carefully removed, tend considerably to promote the size of the insect in its growth. He also, among several other experiments adopted in his treatment of the cochineal, rescinded a portion of the exuberant foliage of the plant, and diminished the quantity of the larvæ on the leaves, so as to afford the shrub a more favorable opportunity of struggling against the innovations of the insect incubus. In this latter experiment he proved successful; and he observed, as the vigor

of the plant was protected, in a corresponding ratio did the cocci increase in size, nor were they enveloped so thickly in flocculent matter as those which were allowed to thrive unattended to and neglected. Cochineal is at this time selling at the public sales in Calcutta for 11 and 12 rupees per seer of two pounds avoirdupois, which is at the rate of 12s. per pound; and yet, strange to say it, the insect abounds throughout India, and with a little pains and attention bestowed upon it, might be converted into a valuable article of commerce, and would, there can be but small doubt, in time expel the presence of the Spanish insect from the market. Correspondent of the Times.

New Metallic Substance.—At the sitting of the French Academy of Sciences, on the 23d ult., M. Peligot submitted a paper on a new analysis of the substance called by French chemists "Urane," which had been hitherto ranged among the simple metals; he had found that it was not a simple substance, but was a compound or oxide of uranium, and that the true metallic base was capable of being seperated from the compound substance. M. Peligot had acted by means of chlorine and potassium, and, having obtained the new metallic substance, which had never before been got pure, had found its atomic weight to be expressed by the tabular number of 750.

On the Original and Proximate Causes of Rain.—Lieutenant Morrison, R. N. has shown, that the quantity of water evaporated exceeds the quantity fallen in the form of rain, in the ratio of 100 to 83. And in order to account for the remaining 17 per cent, he makes the following remarks:—"It has appeared to me, that as the law of decomposition of water by the elastic fluid, is proved to be in exact ratio of the quantity of electricity which traverses the water, and as electrical currents are known to exist in the atmosphere, and must therefore traverse the water suspended therein, much of that water becomes decomposed; and while the hydrogen ascends to perform its task in the superior regions, the oxygen descends to supply that demand which animal and vegetable existence necessarily create." Lieut. Morrison accounts for the proximate cause of rain by electrical induction. Meteor. Soc. Lond.

Bituminous Shale.—A new branch of industry seems likely to organize itself in Belgium. The different produce extracted from bituminous shale, by means of the works established about ten months since on the banks of the canal, near Lacken, merits the attention of consumers, especially the extracts of oil and charcoal. This last production, of which extensive application has been already made in the sugar-refineries, and particularly in that of M. de Vandenberghe de Binkum, at Tirlemont, may acquire great importance at a moment when the depreciation of sugar cannot be balanced but by a diminution of price upon the original materials of manufacture. A reduction of 30 per cent on the price of charcoal, fit for refining, would offer an important advantage, and it is to be hoped, that the experiment may prevail over the prejudices of those, who from habit, stop short on the road of improvement. The works of M. de Binkum are open to all manufacturers, who wish to assure themselves, by personal inspection, of the advantages that the

employment of this kind of charcoal offers. The shale charcoal possesses, moreover, a disinfecting power, which acts instantaneously on all the animal matters, even the most fetid, and transforms them into a powerful manure. These two applications of this preparation alone would suffice to assign an important place to this new branch of industry.
Le Fanal.

Preservation of Meat.—The new process for preserving meat by injecting salt into it by means of powerful pneumatic pressure, will shortly be put into operation at Buenos Ayres and other parts of South America, where it is well known that cattle are extensively slaughtered for the exportation of their hides, the carcasses being completely valueless. The meat thus prepared will form an original article of export to this and other countries, and, should the speculation succeed, our provision markets may be supplied with a new description of animal food at a very cheap rate. So extensive are the herds of cattle and sheep in the immense and productive regions of the Pampas, that a traveller in South America a few years since states, that the carcasses of sheep were used as fuel in heating furnaces. Times.

Improved Bagatelle Board.—The improved bagatelle board is similar in every respect to the one in common use, except that the end of it, where the holes or numbered cups are usually placed, is occupied by a false bottom or movable platform, with numbered cups sunk in it. This platform is covered with the map of part of any country, say Scotland, for instance, and the cups are placed one in each county; or the bottom of the board itself at that end may be covered with a map, and one cup placed in each county.

The counting when playing with this board is regulated as follows:—When a ball is struck into one of the cups, instead of counting towards the game the number of that particular cup, as usual, the player is to be questioned by his adversary as to the name of the country in which that cup is situated, and if the player answers correctly he is to count one towards the game; but if he cannot, and his adversary can rightly name the county, he (that is, his adversary) counts one towards the game. If neither answer correctly, then neither can count, and a reference for the purpose of instruction must be made to an index, in which the name of the county is found, opposite the number of the cup into which the ball has fallen.

The above rule of counting may be varied or extended; and instead of a map, the false bottom may be covered with figures of animals, birds, or insects, a cup being placed in each figure. Inv. Adv.

Fungous Vegetation in Wine Cellars.—A very remarkable kind of fungous vegetation is known to make its appearance in wine cellars, the substance which supplies the growth being the vapor from the wine in the casks or bottles. If the cellar be airy and dry, the vapor escapes, and no fungous vegetation is manifested; but if it be somewhat damp, and secluded from air and light, the fungous growth becomes at once apparent. Round every cork a mould-like vegetation will exhibit itself, and the vapor from the casks rising to the vaulted roof will there afford nourishment to great festoons and waving banners of fungi. In the

wine vaults of the London Dock this kind of vinous fungi hangs like dark woolly clouds from the roof, completely shrouding the brick arches from observation. On a small piece being torn off and applied to the flame of a candle, it burns like a piece of tinder. Should wine escape from a cask in a moist and ill-ventilated cellar, it will altogether resolve itself into fungi of a substantial kind. A circumstance of this nature once came under the notice of Sir Joseph Banks. Having a cask of wine rather too sweet for immediate use, he ordered that it should be placed in a cellar to ripen. At the end of three years he directed his butler to ascertain the state of the wine; when, on attempting to open the cellar door he could not effect it, in consequence of some powerful obstacle. The door was therefore cut down, when the cellar was found to be completely filled with a firm fungous vegetable production, so substantial as to require an axe for its removal. This appeared to have grown from, or to have been nourished by, the decomposed particles of the wine; the cask being empty, and buoyed up to the ceiling, where it was supported by the surface of the fungus. Inventor's Ad.

Salts of Lead.—Chemists have long turned their attention towards the different combinations of water and acetic acid with oxide of lead, and which are so valuable to medicine, to the arts, and to analysis; but the subject is still incomplete. M. Payen, however, has been making some important progress in this branch of chemistry; and the most interesting part of his labor consists in the discovery of a new acetate of lead, and an equally new combination between water and protoxide of lead. In the course of his researches, he has been able to explain several phenomena, the causes of which have been hitherto unknown, and which are highly interesting in the matter of analysis.

Improvements in Stocking Machinery and Stocking Weaving.—In the improved machinery, the needles are made with an extremely short hook, and have no elasticity, being each provided with a lateral slit or recess for receiving the points by which the loops are taken off the needles.

The thread is supplied from above, and is distributed over the needles by a moving piece or carrier. It is then caught by the beaks of a series of levers above the needles, and pressed into the spaces between a series of jacks, also above the needles, instead of pressing it between the needles as usual. The distribution of the thread being thus completed, and the loops formed by the movements of the levers, the depression of the loops for the purpose of forcing them on to the needles is then effected by the descent of the jacks, and at the same time the retiring of the needles takes place. As the revolution of the main shaft proceeds, the needles are again forced forward, for the purpose of narrowing as hereafter mentioned; but are immediately forced back again by the movements of the machinery.

The taking off the loops from the needles is performed by means of a series of needle points affixed on a horizontal bar, at the same time the first three movements of the machine are repeated, and a new loop is placed in the loop of each needle. The needles are then forced backwards, and the needle points rising, and immediately retiring, the loop

they held is liberated, and falling over the new loop in the hooked needle, the frame-work stitch is complete.

The narrowing of the work is effected by part of the machinery, which is thrown into action by the operator when required, and which, when in action, proceeds regularly along with the work, reducing a loop in each selvage at every fourth course, by removing the loops from the two end needles on to the needles next them; and at the same tine limiting the traversing movement of the thread carrier, to a suitable distance for supplying the diminished number of needles with thread.

The needle points and bar may, if desired, be dispensed with; and instead of them the needles may be caused to turn half round during their retiring movement, and thereby allow the preceding loop to pass over the new loop, and so complete the stitch; the new loop being held fast in the hook of the needle.

The improvements in hosiery consist, firstly, in a new fabric, in the making of which a separate thread is used to each needle. This is effected by substituting for the levers before mentioned, a series of distributors, which each carry a separate thread, and the loops are formed on the needles, by the whole of the distributors being supported in a frame, to which a traversing movement is given; each distributor forming loops for two needles alternately. The motions and positions of the jacks and needles remain the same as before described, when the needles made one half a revolution to form the stitch.

Secondly.—In a fabric having a plush or piled surface, in the manufacture of which two threads are used. In making this fabric the loops, instead of being formed by the action of the levers and jacks as at first described, are formed over the needles by means of descending jacks of a peculiar form, moving in succession the same as in the ordinary stocking frame; the lower part of the jacks, which are hooked, having a cutting edge.

The actions of the principal parts of the machine are as follows:—A distributor passes along the whole row of needles while the jacks are elevated, distributing one thread in the opening above the cutting edge of the jack, and the other thread upon the needles. When it has arrived at the end of its traverse, the jacks are lowered in succession, and two loops are formed on each needle, one being a long loop, immediately above the cutting edge, and the other a short loop, under the hooked part at the back of the jack. The needles now retire, and go through the movements necessary to form the stitch; the jacks are then elevated, and the long loop still remaining on the cutting edge is cut by that action, and forms the pile or plush on the surface of the cloth, while the shorter stitch binds it fast in the fabric.

Thirdly.—In a fabric constructed by the ordinary framework stitch, but formed into a cylinder or tube without seam. Ibid.

Sounds Caused by Electricity.—M. Sellier has found it sufficient to place an electric diamond upon a pane of glass in order to produce sounds. When a well polished sewing needle, suspended from a hair, is placed in a glass bowl filled with an acid sulphate of copper, the bowl crackles, even after the needle has been withdrawn, and the liquid poured out. Small currents of common electricity become perceptible

to the ear, by means of a wheaten straw, struck upon a drum of vegetable paper. Ib.

New Hydraulic Apparatus.—The apparatus consists of a metal tube, from six to twelve feet in length, the upper end of which is provided with a nozzle or jet pipe, and to the bottom of it a conical shaped piece or belt is affixed, furnished with a valve opening upward, the passage through which is of the same area as the body of the tube. The diameter of the tube for about two-thirds of its length from the bottom is about an inch and a half, but the remaining third of its length gradually diminishes to half an inch.

The following is the mode of operating with this apparatus:—The bottom of the tube is plunged into the cistern, or other source of supply, and the tube, being held in a vertical or inclined position, is worked up and down by manual or other power with a jerking motion. At each stroke a portion of water finds its way into the tube through the valve, and when the tube is filled, every succeeding stroke causes a jet of water to be projected through the nozzle to a distance of about thirty feet.

When it is desired to raise the water into a cistern, an elbow-pipe is substituted for the jet. If a continuous flow is required, the upper part of the tube has a flexible tube screwed on it, the other end of which is inserted into a fixed air vessel, and closed by a valve opening upward. The intermittent jets are collected in the air vessel, and the air contained in it being thus condensed, the water, by the reäction of the same, is forced through a discharging orifice in a continuous stream. Ibid.

Invention for Compressing Whalebone.—This invention consists in a mode of operating upon strips, pieces, or lengths of whalebone, in order to compress them in width, and thereby increase their thickness, so as to render them suitable for making walking-sticks, whip handles, ramrods, &c.

The strips are first assorted as to length, thickness, and breadth, and placed between two laths of wood, or other suitable substance, and the whole is slightly bound together, and introduced into a steam-tight tube or box, where it is subjected to the action of steam until the whalebone is sufficiently softened. The strip of whalebone still between the two laths is now removed to the compressing machine, which consists of a table or bed, with strong arches thrown over it; upon the bed, within these arches, side-pressers or clamp-pieces are placed, and over the space between these side-pressers is a vertical presser bar. This bar is acted on by powerful levers, worked by means of windlasses and ropes, their shorter ends, which are formed as eccentric wedges, being inserted between the under-side of the arches and the top of the presser bar. The strip of whalebone, with the laths, is placed edgewise upon the bed, between the side-pressers, and the levers being now brought into action, force down the presser bar with great force, and compress the whalebone, the laths allowing it to expand sideways, being, as above mentioned, softened with the whalebone. Ibid.

New mode of obtaining Pigments.—This invention consists in the addition to any waters, holding in solution either the oxide of iron, or

sulphate of iron, copper, or zinc, or any two or more of those substances, of a mixture of quicklime and water, or a solution of any other calcareous substance. By this operation a yellowish-colored precipitate is obtained, which may be either used as a paint in its original state, or may be converted by calcination into a paint of any of the different colors or shades of color capable of being produced by that process.

The waters which most avail for the purposes of this invention, are those which flow from copper, tin, and coal mines, or have drained from the waste or refuse heaps of such mines, after exposure to the atmosphere and rain, and those which have been used for washing or cleaning copper and tin ores. The solution of lime is about the consistency of whitewash, and the quantity used is about one fourth that of the waters operated upon. Ibid.

New process of making Carbonate of Ammonia.—In this improved process, instead of distilling an ammoniacal carbonate direct from any substance or mixture capable of supplying it, as usual, the salt is obtained, either in a solid state, or dissolved more or less in water, by mixing together its separate acid and alkaline constituents.

One of the modes of operating according to these improvements, is to cause ammonia gas and carbonic acid gas to traverse a succession of leaden chambers, maintained at as cool a temperature as may be conveniently practicable, and so contrived as to favor the admixture of the dissimilar gases. Sometimes in one or more of the chambers a stratum of water, or of water impregnated with ammonia, is placed, and carbonic acid and ammonia gases, or carbonic acid gas, is introduced into it, in which cases, in the resulting salt or saline solution, a larger proportion of carbonic acid gas is obtained than when only the hygrometric moisture of the aëriform fluids is present. Ibid.

Improvement in Marine Engines.—This improvement relates to that kind of engines, in which the centre of the steam cylinder (wherein the piston works) is situated, immediately beneath the rotative axis of the crank or cranks, to which the motion of the piston is communicated by a connecting rod, which acts alternately upwards and downwards, so so as to urge the crank round in its intended circular orbit.

The steam cylinder has a small cylinder open at the top fixed concentrically within it, and encompassing this cylinder is the piston, which is a broad ring or annulus, closely fitting the annular cylindrical space between the interior of the large cylinder, and the exterior of the small cylinder. The cover of the steam cylinder is a broad ring, which does not cover the small cylinder, that being left open at top to allow the connecting rod and its appurtenances to work in it.

The connection between the piston and the joint at the lower end of the connecting rod is effected in the following manner:—Two vertical piston rods ascend from opposite sides of the piston, and passing up through two stuffing boxes in the cover, are united at their upper ends to the ends of the horizontal part of a T shaped cross-head. The upright stems of this cross-head descend into the vacant space in the interior of the small cylinder, and are connected at their lower ends to the lower end of the connecting rod by a joint pin passing through them, and

through the connecting rod, which pin (according to the length of the length of the upright stems of the cross-head) may be nearly on a level with the piston, or somewhat higher up, or lower down than that level; but in consequence of this mode of connection, the pin will be moved up and down within the small cylinder, in exact coincidence with the motion of the piston. The T shaped cross-head is composed of two parallel sides, united at the extremities of the horizontal part; a sufficient opening being left between the two sides to admit of the connecting rod working between them.

In order to retain the joint pin at the lower end of the connecting rod in a vertical line during its up and down movement, the lower ends of the two stems of the cross-head have sliding pieces fixed to them, which work in upright grooved straight edges attached to the sides of the small cylinder. Ibid.

Sarcophagi discovered in France.—At the late meeting of the Scientific Congress at Lyons, the Abbé Crozet read a paper on some sarcophagi, discovered near a very old church in the department of Puy-de-Dôme. One of these sarcophagi contained a skeleton, which was covered, first, with a layer of earth; second, a layer of lime; third, one of charcoal; it was enveloped in linen bandages, and was laid upon red and green argil, and aromatic plants, some seeds from which have reproduced rosemary and camomile. By the side of this sarcophagus there were 80 others, each bearing a marble tablet with an inscription; the most remarkable was Vixit annus LXX, instead of *annos*, a solecism which M. Guillard explains by the Saxon pronunciation of *u* in *on*. At the same meeting M. Martin mentioned that the villages of Arbigny, St. Benique, Boz, &c., on the banks of the Soane, are inhabited by descendants of the Saracens. Ibid.

Imitation of Ancient Gems.—The number of persons engaged in fabricating ancient gems in Rome, at the present day, is, we believe, considerable; and there is consequently great difficulty in ascertaining the genuine from the imitations, when the latter are finely executed. But the appearance of antiquity—that must be copied too; and ingenuity has devised a very curious and extraordinary process for producing the effect. The fresh-cut cameo is crammed down the throat of a turkey, and left in its intestines for a sufficient length of time, when the fowl is killed, and it is found that the stone (subject to the trituration of the gizzard) presents every semblance of a Grecian treasure which has been buried 2000 years. Ibid.

Electricity in Steam.—The administrative commission of the Museum of Industry having been informed by the director that M. Tassin, mechanician, at Liege, pretended to deduce from certain circumstances, attending the bursting of different steam-boilers, the inference that these explosions were owing to the presence of the electric fluid in the steam, accumulated when the boilers are not in contact with bodies which are good conductors, has tested these assertions. The experiments to which the commission applied itself, have had the result of disengaging sufficient electricity to produce sparks and electric shocks, very decided.

Up to this, however, nothing has been effected but under a pressure of two atmospheres. The commission continues the experiments in presence of M. Tassin, and is about to experiment on the steam submitted to different pressures. Moniteur.

Improvements in Vinegar Making.—These improvements relate to making vinegar from beet roots, &c. The tops and shoots of beet roots are first cut off, and the roots, after being thoroughly washed, are rasped into a fine pulp, with which a number of bags made of strong cloth are filled; these bags are placed in a powerful press, with a board or hurdle between every two, and are subjected to pressure until the whole of the saccharine juice is extracted from the pulp. The strength of this juice will vary from about 7 to 9 deg. of the areometer, and must be reduced by the addition of water to 5 deg., and then boiled for a short time. The liquid, or "worts," is now removed to the coolers, in which it remains until the temperature falls to 60 deg. Fahr. It is then conveyed to the fermenting vat, half a gallon of good yeast being added to every hundred gallons of wort. When the fermentation is ended, the fermented wash is pumped into the acidifying vessel, and is there converted into vinegar, as will be presently described.

The acidifying or air-forcing apparatus consists of a strong vat capable of containing 24,000 gallons; in the centre of which, a short distance above the bottom, a rose or small inverted dome is fixed, pierced with numerous small holes, and communicating by a pipe with a blowing apparatus. Upon the bottom of the vat a steam worm lies, one end of which is connected to a steam boiler, and is furnished with a steam cock, and the other end is open to the atmosphere. The interior of the vat is divided into several compartments, by means of diaphragms or false bottoms, pierced with small holes, and the cover of the vat is provided with a valve, which opens outwards upon a very slight pressure from within. The vat is likewise furnished with a thermometer, the bulb of which is immersed in the liquid contained in the vat, in order to indicate the temperature of the same.

The following is the mode of converting the fermented wash into vinegar by means of this apparatus:—2000 gallons of vinegar are first let into the vat, to serve as "mother" to an equal quantity of fermented wash, which is introduced at the same time, and a little yeast being added, the whole quickly enters into the acetous fermentation. When the fermentation is fully set in, air is forced into the vat by the blowing apparatus, which air, in its passage through the small holes in the false bottoms, is brought into intimate contact with the liquid, imparting to it a portion of its oxygen, and expelling through the valve in the cover the carbonic acid gas evolved during the course of the fermentation. As soon as the temperature of the liquid falls below 70 deg. Fahrenheit, a current of steam is admitted into the worm, so as to maintain the temperature constantly between 70 and 80 deg. Fahrenheit.

By this means the liquid will in a few days be converted into vinegar; and when that is effected, 4000 gallons more of fermented wash are let into the vat, and the above process being continued, the whole 8000 gallons will in a few days be converted into vinegar. This process is continued until the vat contains 24,000 gallons of vinegar, and when the

acetous fermentation has ceased, 8000 gallons are drawn off and clarified by the ordinary means. 8000 gallons of fresh wash being now pumped into the vat, will in a few days become completely acidified, and that quantity of vinegar may be withdrawn from the vat, and replaced by a like quantity of fresh wash, and so on continuously. Ibid.

New mode of forming Mercurial Compounds.—This invention consists in combining chlorine in the state of gas, with the vapor of mercury or quicksilver, in order to produce calomel and corrosive sublimate.

The apparatus employed consists of a glass, earthenware, or other suitable vessel, mounted in brickwork, and communicating at one end with a large air-tight chamber, and at the other end by means of a bent tube, with an alembic, such as is generally used for generating chlorine gas. The alembic is charged with a mixture of common salt, binoxide of manganese and sulphuric acid, or of binoxide of manganese and muriatic acid, in order to produce chlorine gas.

The mode of operating with this apparatus is as follows:—A quantity of mercury or quicksilver is placed in the glass vessel, and the temperature of the same is raised to between 350 deg. and 660 deg. Fahr., by means of an open fire beneath. The chlorine gas as it is generated, passes from the alembic through the bent tube into the glass vessel, and there combining with the vapor of the mercury, forms either corrosive sublimate or calomel, according to the quantity of chlorine gas employed. The product is found at the bottom of the air-tight chamber, and may be removed from the same through a door, when the operation is finished. Ibid.

Improvements in the manufacture of Picture Frames and other Articles.—This invention consists, firstly, in a method of manufacturing picture and other frames of copper.

A mould is first made of the required design, and from it a series of reverse or intaglio moulds are produced by the common process of casting. The mould thus formed, if not a conductor of electricity, is made one, and being placed in connection with a voltaic battery, copper is deposited on it of the required thickness by the usual process. When this is effected, the mould is removed from the battery, and the copper frame which has been formed is detached from it. The back of the frame is now filled with solder, in order to make it level, and a slip of metal is fastened round it to receive the picture and glass, being what is usually termed the "rabbitt." The frame is now ready to undergo the process of gilding, &c.

Secondly.—In a similar method of manufacturing moulds and other patterns, from which ornaments may be cast in the material called by carvers and gilders "composition," and in *papier maché*, being suitable also for glass, earthenware, and china.

An obverse mould or exact model of the required ornament is procured, and is fastened to a perfectly flat or smooth surface, which, together with the model, is rendered a conductor of electricity, and copper of the required thickness is deposited on them by the electrotype process. When the mould is formed, the back of it, which is rough and uneven, is tinned, and then any suitable metal in a molten state is poured

on it, and the back is rendered quite level; this is done in order that the mould may not be injured by the press in making the ornaments. The mould is now inclosed in a wooden box, leaving the face of it only exposed.

Thirdly.—In a method of manufacturing obverse moulds or patterns in copper, for the purpose of casting or founding decorative ornaments in iron. A model or pattern being obtained, a cast is taken of it, which will be the reverse of the original; this cast is rendered a conductor of electricity, and is then placed in contact with a voltaic battery, and copper is deposited on it. In order that the back part of the mould or copper deposit shall present a smooth surface, the cast on which the metal is to be deposited is placed horizontally in the vessel containing the solution of a salt of copper, with its face downwards, instead of being placed perpendicularly, and upon the bottom of the vessel, the copper surface, which supplies the copper for the deposit, is placed. The copper deposit or mould obtained by this process, is ready to be used as an obverse mould, for making impressions in sand, as usual in casting iron.

Fourthly.—In methods of covering the surfaces of metallic picture and other frames with gold; applicable also to other surfaces, and to raise or emboss devices in gold or its alloys.

For this purpose a solution is first prepared, to occupy the place of the solution of a salt of copper, and is composed of pure gold or any of its alloys, dissolved in bromine, and to this mixture a few drops of sulphuric acid is added. The surface to be gilt, having been cleaned by any of the usual methods, is immersed in this solution, and is connected by a wire with the positive pole of a voltaic battery; in like manner the surface to be eroded or dissolved, which is of gold, is immersed in the solution, and is connected to the negative pole. The battery being now put in action, gold is deposited of any desired thickness, and the surfaces covered with gold by this method, are treated in the same manner as if gilt by the usual way.

Fifthly.—In methods of covering with silver surfaces similar to those mentioned in the fourth part of this invention.

These methods are in all respects similar to those adopted for covering with gold, except in the mode of preparing the solution, which is as follows:—Silver is dissolved in bromine and alcohol, by the aid of the galvanic battery; and this solution is allowed to remain at rest until a yellowish white precipitate takes place. The fluid portion is now decanted, and the precipitate is dissolved in 30 parts its weight of a saturated solution of acetate of ammonia, by being boiled together for ten minutes. A solution may likewise be formed of iodine and silver, for the above purposes, by dissolving an iodide of silver, prussiate of potassa, or any of the ammoniacal salts.

Sixthly.—In methods of covering metallic surfaces with platinum, applicable to the purposes mentioned in the fourth part.

A solution is first prepared, by mixing a quantity of platino-bichloride of ammonia with 60 times its weight of water, to which three parts of muriatic acid have already been added, and the mixture being then boiled about ten minutes is fit for use. It is used in place of the usual solution of a salt of copper.

When bromine is used with platinum, the metal is procured in a

highly comminuted state, being what is called spongy platinum, and to it, bromine mixed with its bulk of alcohol is added, and the whole is stirred or shaken to promote dissolution. This solution is combined with half its bulk of dilute sulphuric acid, containing six times its weight of water; it is then ready for use, and is employed in the same way as the preceding one.

In order to cover surfaces of lead with platinum, the lead is first cleaned by the usual methods, and is then immersed in water, containing half an ounce of either of the solutions of platinum to half a gallon of water. It remains in this for six hours, and on its removal will be found to have changed to a dark brown color. If a more permanent coating is required, the lead is connected with a voltaic battery while in the solution, which, in this case, may be double the strength mentioned. Lead thus covered is applicable to surfaces used for the negative element, or plates of galvanic batteries.

Seventhly.—In an improved method of covering metallic surfaces with tin, applicable to the purposes mentioned in the fourth part.

The metallic surface to be covered is first cleaned by any of the usual methods, and is then, together with a surface of solid tin, placed in a solution of acetate or muriate of ammonia, or sulphate of soda, and connected with a battery, which being excited into action, tin is deposited of the required thickness.

Eighthly.—In methods of cleaning the surfaces of iron, and in covering those surfaces with copper, by the agency of voltaic electricity.

The iron surface to be cleaned is attached by a wire to the platinum end of a voltaic battery of three pairs of plates, each plate having as much surface as the iron to be cleaned; another surface of iron is likewise attached to the zinc end of the battery, and the two surfaces are immersed in a saturated solution of sulphate of soda, and the battery is put in action. In a few minutes the surface will be brightened, if it is malleable iron; but if it is cast iron, the immediate surface will be deprived of its iron, and the carbon contained in it will be exposed; in either case, it is ready to be deposited on. In order to deposit copper on the surface, it is immediately attached to the zinc end of a battery having a similar number of plates to the preceding one, and a piece of copper is attached to the platinum end of the battery; the copper and iron are now immersed in a solution of a salt of copper, and the battery being put in action, copper is deposited on the iron surface.

Ninthly.—In a method of producing enriched surfaces, applicable to picture and other frames and cornices; also applicable to other interior decorations.

This improvement consists in producing all manner of enrichments, applicable to the above purposes, by the use of embossed or enriched calico, or other similar fabric; the enrichments are produced on the fabric by pressing it between rollers or blocks, which have the required pattern depicted on their surfaces. This fabric is then cut into pieces of the required size, and fastened to the surfaces it is required to enrich; a coating of thick whiting being first applied to the surface, so as to fill up all the hollow spaces of the embossed fabric, in order that it may present a solid surface when dry.

Tenthly.—In a method of improving the texture of the composition,

used to cast ornaments for picture and other frames and cornices, applicable to other decorative purposes.

This improvement consists, in the addition to the usual materials of which the above composition is composed, of caoutchouc or India-rubber, dissolved in spirits of turpentine, or asphalte or pyroligneous spirit, or spirit of tar, in the proportions of 1 lb. of India-rubber to every 6 lb. of glue used in the composition. Ibid.

Improvements in the manufacture of Soap.—These improvements consist in making hard soap at a single operation in the ordinary open boilers, coppers, or pans, without separation of lees or *niger*, or the necessity of incurring the expense of highly concentrated lees. This is effected by the use of some or all of the following ingredients, viz., cocoa-nut oil, palm oil, decolored by acids or otherwise, tallow oil, and potash lees; also the muriate of soda and the muriate of potash. The general rule for the employment of these materials will be sufficiently explained by the following descriptions of the modes of making white soap, and fulling soap according to these improvements. The specific gravity or strength of the lees are measured by Beaumé's hydrometer, which is employed at a temperature of 62 deg. Fahr.

White soap is made of the following ingredients:—2072 lbs. of cocoa-nut oil, either in its imported state or deprived of its rancidity by the processes hereafter described; 168 lbs. of olive or other sweet oil or tallow; 375 gallons of soda lees, marking 24 deg. by the hydrometer; and 60 gallons of soda lees, marking 20 deg. The cocoa-nut oil, and the other oil or tallow, are first put into the soap copper, and heated by fire or steam; 10 gallons of the soda lees are then added, and allowed to boil up and unite with the mixture; the same quantity of lees is added afterwards, from time to time, keeping the materials at the boiling point. When the whole of the soda lees have been poured into the copper, the compound is boiled up for half an hour, and then the potash lees are added, proceeding the same as with the soda lees. The whole of the potash lees having been added, the compound is boiled up for about ten minutes, and then about 84 lbs. of muriate of soda or potash, are sprinkled slowly over its surface. After this, the soap is boiled for about half an hour, and the fire or steam being withdrawn, the manufacture of soap is complete, and will be of the consistence of melted glue. It is allowed to cool down, and is afterwards cleansed or framed in the usual way.

In the manufacture of the common sorts of soap, the potash lees are sometimes omitted.

The mode of making a hard soap for fulling and other purposes, and the ingredients that compose it, are as follows:—1792 lbs. of cocoa-nut oil; 336 lbs. of tallow; 224 lbs. of olive oil; 112 lbs. of rape oil, or decolored palm oil; 400 gallons of soda lees, marking 25 deg.; and 80 gallons of potash lees, marking 20 deg.

The copper is charged with the whole of the materials, and the fire or steam is applied, and the operation is conducted, in precisely the same manner as when making the white soap, except that the muriates of soda or potash are omitted. As soon as the soap is made, 2240 lbs. of grained, or curd soap, made on the old system, is added, and the two

soaps are boiled up until perfectly incorporated. The soap is then allowed to cool down, and is afterwards cleansed or framed in the usual way.

The rancid odor is removed from cocoa-nut oil in the following manner:—10 cwt. of the oil is boiled by steam in a wooden vessel, and to it 3 lbs. of sulphuric acid, or 5 lbs. or 6 lbs. of muriatic acid are added, and the boiling is continued until the rancid odor is removed, or else the oil is boiled alone in an iron pan, by means of dry heat, for a sufficient length of time. Ibid.

New mode of Disconnecting Paddle Wheels.—This invention consists in giving a horizontal motion endways to the paddle shaft, in order that its crank may be withdrawn from, or put in connection with, the crank pin of the driving shaft, which enters a recess in that crank in order to drive the same. The mechanism for moving the paddle shaft endways may be constructed on different plans, but the following is preferred by the inventor:—The neck of the paddle-shaft is made considerably longer than the lower brass of its bearing, in order to allow of its moving the required distance endways; but the upper brass exactly fits the space between the shoulders of the neck, and moves with it. The upper brass is capable of sliding endways horizontally in a cap above it, and has a recess formed in the upper part of it to receive an eccentric, fastened on the lower end of a vertical axis, which passes upwards through the cap, and terminates in a toothed wheel; to this wheel motion is communicated by means of an endless screw, the axis of which is elongated, and is provided with a handle to turn it by.

The eccentric being turned round by means of the endless screw and and toothed wheel, will move the paddle-shaft with the upper brass endways, and so disconnect or connect it with the crank-pin of the driving-shaft; the paddle-shaft being retained in any position in which it may be placed by means of palls. Inventors' Adv.

New Process for Soldering Metals.—Two intelligent French mechanics attended at the plumbers' shop in the Woolwich Dockyard, on Wednesday last, to show the workmen and a foreman from each of her Majesty's other dockyards a new invention for soldering or joining metals without solder. The mode of operation was discovered by Le Comte de Richmond, who has taken out a patent for it in this country. The invention is applicable to brass, copper, lead, pewter, and zinc, and the process is very simple. It merely consists of the application of a powerful heat from a small tube exactly similar to a blow-pipe, attached to a pliable hollow thong woven similar to a whip, but made air tight, at the end of which is placed two stop-cocks, the one to admit hydrogen gas, generated on the spot by placing sulphuric acid, mixed with water, upon the cuttings of zinc in a vessel constructed for the purpose. The other stop-cock admits atmospheric air in any quantity and with great force, when requisite, as it is assisted by a small portable bellows, worked with the foot upon a pedal. The foremen of the various yards tried a number of experiments with lead, both with flat and round pieces, and formed joints, all of which they performed in a very satisfactory manner, and appeared at once to comprehend the whole theory of the discovery. Ibid.

China Grass Cloth.—If any person will be at the trouble of cutting a leaf from an aloe plant, which is reared and encouraged as an exotic in this country, he will, upon close inspection, detect a course of long white fibres, possessing considerable tenacity. These, when elicited from the fleshy part of the leaf, and placed together by themselves, will exhibit a very beautiful clean hemp, corresponding precisely with the material of which the linen called China grass-cloth is composed. The aloe grows wild and in great abundance throughout China, and the people of that country have turned it, as they do everything else, to a profitable account. The flax which constitutes the fishing lines known under the name of Indian twist, but which is in reality a Chinese production, is manufactured from the same identical commodity. There are many Chinese inventions, at present retained as a monopoly by the above people, which are easily capable of being arrived at by those of other countries, if proper attention and a very moderate share of curiosity were bestowed upon the subject. Ib.

New mode of preserving Paints.—The paints or other fluids are inclosed in tubes or cases of drawn tin, the ends of which are secured by bringing the opposite sides of the end parallel to each other, and then folding them over once or twice, similar to a hem in needlework. The seam or joint thus formed is made air-tight, by squeezing it with a pair of pincers; or, for the sake of greater convenience, in obtaining the contents of the tube, one end of it may have a nozzle or spout, furnished with an air-tight cap.

The operation of filling the tubes is performed as follows:—One end of each tube being closed, either by the joint above described, or by the nozzle and cap, the tube is first placed in a horizontal position, and into its open end the spout of a funnel is inserted, completely filling its interior; then by means of a piston, working within the funnel (which is partly filled with paint) the paint that it contains is forced into the tube, which by the pressure of the paint is gradually forced off the funnel, and the end of it is then secured in the manner above described.

When the paint is required for use, the cap is taken off the nozzle, and the paint is expressed by pressing the sides of the tube together, commencing at the bottom; and as the sides remain in contact with each other after the pressure is removed, the admission of atmospheric air is prevented. Ib.

The Great English Manufacturers.—The present Arkwright is the son of Sir Richard. He has an income derivable from estates worth perhaps £400,000, which he manages himself without any steward or agent. Mr. Strutt, the M. P. also is the son of Sir Richard's old partner, who is, I believe, still alive, and of very advanced age. The good fortune of this gentleman, who was originally brought up in Sir Richard's factory, is narrated thus:—The thread wound round the bobbing after its being spun used to ride over the end of the bobbing or reel and break. It slipped or slided over, and Arkwright could not remedy the defect. Strutt was walking one day with him, when the latter said to Strutt, "If you could but find out the way to make this concern work better, I would make a man of you. You shall have a share in the

business." "How much?" instantly inquired Strutt of his master. The amount was immediately mentioned, and Strutt being satisfied, at the same time relying most confidently on Arkwright's honor, took out of his pocket a piece of chalk, and proceeded to chalk over first one bobbing and then another, and so on to twenty bobbings, so that the thread could not pass or slide over the surface so treated, and kept therefore in its proper place. Arkwright saw this, and admired its simplicity, and desired Strutt to do the whole; which, being accomplished, Arkwright completed his bargain by giving Strutt a share in the concern, and treating him thenceforward as his partner. On another occasion Strutt was asked to remedy another great defect in the machinery, connected with the raveling of the thread or web. Strutt asked for a pair of scissors, cut off a bit of the flap of his own coat, made a small round washer, with a hole in the centre, placed it under the wheel, and thus prevented its vibration, by which the raveling of the thread was occasioned—a glaring and injurious defect in every species of cotton manufacture. The old gentleman, who is in full possession of his faculties, is said to be anxious to dispose of the whole of his prodigious concern, which affords employment to nearly all the hands in Belper and Milford. Granville.

Improved Locomotive.—Messrs. Coulthard, of Gateshead, engineers, have just completed a powerful locomotive engine, including all the modern improvements, with also, in one respect, a novelty in construction of great practical advantage. This consists in the rejection of what we may call the "cinder chamber," so that the bars are exposed to the external atmosphere, and the ashes fall directly upon the ground. Thus, the bars being presented to the cold air on the outside, they do not waste away with that rapidity which is consequent upon the ordinary construction, and considerable economy is the result. The engine being built more for power than for speed, the works are placed chiefly on the outside, and are of peculiarly easy access for purposes of repair. Trial was made of her powers on Thursday week, in the presence of Mr. Wood, under whose superintendence she was built, and other gentlemen, who were much gratified by her performances; and after remaining for experiment on the Brandling Junction Railway a few days from this time, she will be removed to the Clarence line, to commence her labors in good earnest. Tyne Mercury.

Gas from Anthracite Coal.—A patent for producing gas, by passing steam through a retort charged with anthracite, has been taken out by E. O. Manby, Esq. C. E. of Swansea, a gentleman possessing a thorough local knowledge of the anthracite district of South Wales, and who has had the best opportunities of judging of the powers and capabilities of the coal. He produces gas of great illuminating power rapidly and abundantly, which requires no purification.

On the Green Color of Plants.—Although we are justified by the mass of evidence in asserting that the green color of plants is owing to the fixation of carbon in their tissue, in consequence of the power that light possesses of decomposing their carbonic acid, yet there are some excep-

tions that deserve attention. Humboldt found that *Poa annua* and *P. compressa* (two grasses) *Plantago lanceolata, Trifolium aruense,* (clover) wallflower, and the *Rhizomorpha verticillata,* were *green* in the subterranean galleries of the mines of Freyberg, although born in *total darkness,* but in atmosphere highly charged either with hydrogen or nitrogen. Ferns and mosses again will be green when other plants are *blanched;* and Humboldt found near the Canaries a fucus *(sea-weed)* which was bright grass green, although it had grown at the depth of from 25 to 32 fathoms (150 to 192 feet.) Now as light, according to the experiment of Bouguer, after traversing 180 feet, is weakened in the proportion of 1 to 1477.8, this fucus must have been illuminated when growing by a power 203 times less than that of a candle at a foot distance. Are we to suppose that this feeble degree of illumination was sufficient to decompose the carbonic acid of such a plant, or was not the decomposition rather owing to the operation of some unknown cause? Lindley's Botany.

DESCRIPTION OF AMERICAN PATENTS

Granted from Sept. 4th to Sept. 30th, 1841.

Improvement in the method of attaching Suspender Straps to Pantaloons. By David B. Cook, New-York. Sept. 4th.

Claim.—What I claim as my invention, and desire to secure by letters patent, is combining the suspender with the waist or waistband of the pantaloons, by means of the strap attached to the pantaloons, as herein set forth.

Improvement in the manufacture of Leather Hats. By J. S. and Wm. Wibirt, Eden, New-York. Sept. 4th.

Claim.—What therefore we do claim as our own invention, and desire to secure by letters patent, is the new fabric described above, consisting of hat and cap bodies made of leather without seams.

Improvement in the Steam-Engine. By William Whitham, Huddersfield, England. Sept. 4th.

Claim.—What I claim as the invention, is the combination of the peculiar piston and BBB′ C within a steam cylinder A, having suitable steam ways and slides or valves, by which the steam having acted by high pressure on one side of the piston, may pass into the cylinder on the other side of the piston, and act by expansive pressure on the larger area of the piston, and thus produce the return stroke of the piston, as described.

Improvement in the manner of uniting an Auger to the Sinker for Boring Artesian Wells. By William Morris, Kanawha Co., Va. Sept. 4th.

Claim.—What I claim as my invention, and desire to secure by letters patent, is the method of uniting the auger with the sinker, by means of the sliding connection, substantially as herein described.

Improvement in the Horse Power for Driving Machinery. By MOSES DAVENPORT, Pittsburg, Pa. Sept. 4th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the employment of the hollow cylinder attached to the sweep-plate *b*, having openings through which the driving wheels EE communicate motion to the pinion *i* working within it, for the purpose and in the manner specified: and I also claim the support *p*, (having a channel for the reception of oil, into which works the lower part of the hollow cylinder,) in combination with the hollow cylinder *a*, for the purpose and in the manner specified.

Improvement in the manner of constructing Berths for Vessels. By HARMON KING, New-York. Sept. 4th.

CLAIM.—I do not claim as my invention any of the separate parts of the vessel's berth herein before described; but what I do claim as my invention, and wish to secure by letters patent, is the combination of the movable berth-front aforesaid, with the metal arms, hinges or rule-joints, or in any other substantially the same; so that a good and proper berth may be readily and expeditiously adapted for use upon that which appears to be, and is used for, an ordinary seat or locker.

Improvement in Self-Acting Apparatus for supplying Boilers of Steam-Engines with water. By JOHN HAMPSON, New-Orleans, La. September 4th.

CLAIM.—I do not claim to be the first to have invented a self-operating mode of supplying steam-boilers with water from a reservoir attached to said boiler, by constructing the boiler with a float on its interior attached to a lever governing a valve, which, when operated by the descent of the float, opens a passage between the reservoir and boiler for the water to pass, in permitting the steam at the same time to press through another passage on the surface of the water in the reservoir. Nor do I claim, in combination with this arrangement, a mode of supplying the reservoir with water by forming a vacuum within it, and forcing the water up by atmospheric pressure; but what I do claim, and for which I desire to procure letters patent of the United States, is the particular manner in which I have combined the float and valve of the boiler with the reservoir and boiler, and the passages connecting them by means of a cylinder and pistons of peculiar construction and the apparatus connected therewith, and also combining with the same the float and bore within the reservoir and the tube for supplying said reservoir with water, so as to produce a self-acting apparatus both for supplying the boiler and reservoir with water; that is to say, I claim, first the combining with the reservoir A, A, which receives the water for supplying the boiler, the connecting tube 9, the cylinder *b*, the pistons *d, d*, the bars, *f, f*, and the valve *g*, constructed and operating substantially as set forth.

2d. The combining with the foregoing apparatus, the float, lever, and valve within the boiler for admitting steam into the tube 9, on the descent of the float 5, the pipe *h*, for supplying the reservoir with water,

and the tube U, for conducting it into the boiler; the whole being constructed and operating as described.

3d. I claim the mode of governing the supply valve *g*, and regulating the admission of steam into the reservoir, by means of the lever M, M, provided with a float R, and a counterbalance Y, and furnished with catches *n*, *n'*, as set forth and combined with the bars *f*, *f*, having studs or pins *p*, *p'*, to which said catches are adapted in the manner and for the purpose herein described.

4th. Combining the whistle or alarm C, with the cylinder *b*, steam-pipe 9, and pistons *d*, *d*, as set forth for the purpose of giving an alarm when the water is low in the boiler.

Improvement in the construction of Water-Wheels. By JESSE TAYLOR, Aurelius, New-York. Sept. 11th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is the before described construction of the water-wheel, in combination with the trunk collar and shoot for admitting the water through the centre of the bottom of the wheel to the interior thereof, and causing it to escape near the circumference through small apertures, which has the effect of turning the wheel in a contrary direction to that of the escape of the water; that is to say, combining with the trunk, collar, and shoot aforesaid, a hollow drum or wheel constructed with a circular rim and a concave convex head fixed to said rim, and to which head the shaft is fixed, and with a bottom, which is also fastened to the said rim with a circular aperture in the centre of said bottom for the admission of water, and a series of small apertures near its periphery in a circle, concentric with the circle of the centre aperture for its discharge, the interior being hollow, with a rim made in segments or less diameter than the outer rim, arranged in a circle concentric with the outer rim, forming a space between the two rims, in which are arranged inclined planes over the before mentioned small apertures, the approach to which are also inclined planes formed on the bottom, over which vertical heads are fixed, between which four the last mentioned inclined planes the water passes to the issues from the centre of the wheel through spaces in the inner segment rim, as before described.

Improvement in the machine for Shrinking Bodies in the manufacture of Felt Cloth and Hat Bodies. By HENRY A. WELLS, New-York. Sept. 11th.

CLAIM.—The principle of this improvement which I claim as my invention, consists in the mode of operation, whereby the material to be shrunk, contracted, or felted with rapidity and evenness, is subjected to the direct action of steam, and afterwards only to a dry heat, in a double vessel kept all the time in motion, so that the material may be exposed on every side to the action of the steam or heat during the operation as aforesaid. It is obvious that an outer and inner vessel, of any form and dimensions, may be used, and yet the principle be the same. I have described the form I prefer. But I claim as my invention, the use of any mechanical means operating substantially in the same mode to produce the same effect.

Improvement in the method of constructing and arranging the Grates of Stoves. By GARDNER CHILSON. Boston, Mass. Sept. 11th.

CLAIM.—I shall claim as my invention, extending one of the journals of the grate through to the outside of the stove, and by means of a lever inserted therein, in combination with the projections above mentioned, obtaining an easy process by which the ashes may be shaken or sifted from the coal, and the coal may be removed from the grate, while the same is entirely closed; the whole being constructed and operating substantially as above specified.

Improvement in the mode of Salting Animal Matters. By CHARLES PAYNE, South Lambeth, Great Britain. Sept. 11th.

CLAIM.—What I claim is the mode of preserving animal substances by means of a vessel A, combined with an air pump for exhausting it, and a reservoir containing brine, the whole being constructed and operating in the manner set forth. Also the method of constructing the reservoir *a*, with a false bottom perforated with apertures, in combination with the pressure pump for forcing the brine through the animal matters.

Improvement in Window Fastenings. By ENOCH ROBINSON and WILLIAM HALL, Boston, Mass. Sept. 11th.

CLAIM.—We shall claim as our invention, constructing the fastening end of the lever, or turning button, of a horizontal hollow cylinder closed at one end by a screw stopper, or otherwise, and arranging in said cylinder a spiral or helical spring and loose pin; the whole being constructed and operating together substantially in manner, and for the purpose above described.

Improvement in the construction of Cooking Stoves. By JAMES ROOT, Cincinnati, Ohio. Sept. 11th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the manner of arranging and combining the respective parts constituting the fire-chamber, the ashpit, and the hearth; said arrangement and combination consisting of the fire-chamber and ashpit separated from each other by the grate bars CC only; which grate bars are each of the ordinary width of such bars, and each hung upon pivots, and connected with a handle, by which they can be shaken or closed at pleasure; and of an independent hearth, not connected with any plate of the stove, excepting by the brackets used to attach it to the front plate, all as set forth. By which arrangement I am enabled to employ such a grate and ashpit as are herein described and represented, which cannot be done where the hearth plate constitutes a part of that which supports the fire.

I claim also the combining and arranging, in the manner set forth, with the boiler space over the oven, and the direct opening to the stove pipe M, a damper N, so constructed and arranged as that when drawn out it shall intercept the draught of heated air, and cause it to pass in the vicinity of the rear cooking utensils.

Improvement in the Conical Grist Mill. By SAMUEL SHELDON, Cincinnati, Ohio. Sept. 11th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the manner in which I have arranged and combined the spout R, the tube S, and the nut or cone Q, for the purpose of collecting the meal or other article that has been ground, and of preventing dust from passing into the oil box, as set forth.

Improvement in the construction of Vessels or Apparatus for Preserving Paint, &c. By JOHN RAND, citizen of the U. S. residing in England. Sept. 11th.

CLAIM.—I wish it therefore to be understood that I do not confine myself to the means of forming such vessels *a*, so long as they are suitable for carrying out my invention as herein described, nor do I confine myself to the shapes herein shown and described; but what I do claim is the mode herein explained, of preserving paint and other fluids in close vessels, so formed as to allow of portions of such fluid being from time to time withdrawn, and the space previously occupied filled up by the collapsing of such vessels (or parts thereof) by slight pressure, and the openings closed from time, as above described.

Improvement in the method of Pressing Tobacco into Boxes. By ALBERT SNEAD, Richmond, Va. Sept. 11th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the application of the frames and partitions, constructed and combined as described, to binding up and confining tobacco boxes while they are filled and pressed during the process of manufacturing tobacco, by means of which a plurality of tobacco boxes may be filled and pressed at one and the same time, under the same screw or other power press. By my plan of confining the tobacco boxes, tobacco may be in the process of manufacturing more economically pressed into boxes of the usual size, than in the common way, and may be economically into much smaller boxes than those in general use.

Improvement in the construction of Lamps for burning volatile ingredients. By ISAIAH JENNINGS, New-York. Sept. 11th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the employment of two separate reservoirs for the supply of a lamp or lamps, which reservoirs are to contain volatile ingredients of different natures, and which volatile ingredients are to be conducted into separate chambers in the burner, in which chambers they are to be evaporated, and their vapors are to be made to commingle in a gas or vapor chamber, whence it is to escape through suitable holes for the purpose of being ignited; the respective parts of the apparatus for effecting this object being arranged and combined substantially in the manner herein set forth.

Improvement in the machine for Fulling, Milling or Planking Felt Cloths, &c. By HENRY A. WELLS, New-York. Sept. 18th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the method herein described, of subjecting the material or

bat to the action of moist and dry heat, in combination with the method above described of applying pressure.

Improvement in the Machine for Hardening Felt Cloths. By HENRY A. WELLS, New-York. Sept. 18th.

CLAIM.—What I claim in the above described machine, is the method herein described of applying to the bat, moist and dry heat in combination with the method herein described of applying friction thereto.

Improvement in the construction of Lamps for Burning Tallow. By MOSES S. WOODWARD, Marshalton, Pa. Sept. 18th.

CLAIM.—I do hereby declare that I do not claim the using of a rod or wire of metal to conduct the heat from the frame of a lamp, to preserve the fluidity of the material contained therein, this having been done before; but I do claim the so constructing of a lamp for burning materials of the kind above named, as to combine the said method of keeping the materials fluid, the means of tilting the body of the lamp in any required degree, for the purpose and substantially in the manner herein described.

Improvement in Railway Cooking Stoves. By R. P. BUTRICK, Lockport, N. Y. Sept. 18th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the combining the two principal parts thereof, by causing the two flues C and D to enter and slide within the two flue spaces C′ and D′ in such manner as that when said flues are passed into the flue spaces to their whole depth, the stove shall contain two ovens only; and that when drawn out to the proper extent, said flue shall constitute the upper and lower portions of a third oven, requiring only the application of two doors to render it complete; the respective parts being arranged, combined and operating substantially as herein set forth.

Improvement in the Steering Brace for Boats. By HOWARD NICHOLS, New Bedford, Mass. Sept. 18th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the method of steering boats by passing the oar through a ring of metal, which is connected with the stern of the boat by a double joint, constructed substantially as herein described, by means of which the oar can be moved vertically and horizontally, as herein described.

Improvement in the Axle and Hub for Carriage Wheels. By HENRY F. PHILLIPS, Skaneateles, N. Y. Sept. 18th.

CLAIM.—What I claim as my invention, and desire to secure by letters patent, is the employment of a tube or thimble, made of brass or composition, on the arm of the axletree, so secured that the hub revolves upon it, while it is susceptible of being turned on the axle to shift the bearing front to some other part of its circumference, in manner substantially as herein described. I am aware that the tube or thimble has

been used on the arm of the axletree, but in such cases it has been permanently attached to the axle, and could not be shifted, &c.; therefore I do not wish to be understood as making a claim to a thimble simply, but confine my claim, as above, to the employment of such a thimble, when movable on the arm of the axletree.

I also claim the method of retaining the hub on the axle by means of the screw box, in combination with the movable tube or thimble, as herein fully described.

Improvement in the Permutation or Combination Lock. By J. B. Gray, Fredericksburg, Va. Sept. 18th.

Claim.—What I claim therein as new, and desire to secure by letters patent, is the dividing of the end plates of said lock, on their peripheries, into a considerable number of equal parts, coinciding in size with the divisions on the revolving rings, either of which divisions, whether designated by letters, figures or blank spaces, may be made the starting point in setting the revolving rings. And

I likewise claim in combination with the foregoing, the so constructing the revolving rings as that one portion of them shall require to be set by the spaces intermediate between the letters, figures, or other marks thereon, so as greatly to enhance the difficulty of opening the lock, from the manner of constructing it, substantially as set forth.

Improvement in the Figured Damask Hair Seating. By Samuel Ross, Camden, N. J. Sept. 18th.

Claim.—I claim the invention of producing a satin or twill'd groundwork, and at the same time I produce a full satin or twill'd figure of any color, by the extra warp, which when combined produce a full satin or twill'd face on the goods. The old mode of manufacturing figured damask hair seating is to make a satin or twill on one part of the goods only, where my improvement produces a full satin on the whole face of the fabric, both figure and ground. Therefore, my claim is for the making of a satin or twill'd ground-work, at the same time making a satin or twill'd figure.

Improvement in the mode of setting Potash Kettles. By Daniel B. Turner, Florence, Ohio. Sept. 18th.

Claim.—What I claim as my invention, and which I desire to secure by letters patent, is making the furnace with the two covered lateral or branch flues F^3 in combination with the connecting flues F^4, F^5, furnished with dampers for regulating the degree and changing the direction of the heat under and around the boilers, as before described.

Improvement in the Machine for driving Piles. By Robert N. Benson, New Orleans. Sept. 18th.

Claim.—What I claim as my improvement, and of my own invention or discovery, in the above described machine, and for the use of which I ask an exclusive privilege, is the method of raising the monkeys or hammers H, in succession, by means of the endless chain or belt D, constructed and operating as herein described. And I also claim the

double spring guide, constructed in the manner and for the purpose herein described.

Improvement in the Prismatic Blocks of Wooden Pavements. By JOHN ABBOTT, Wilton, N. H. Sept. 25th.

CLAIM.—I shall claim constructing the prismatic blocks of pavements with grooves and tongues on their sides, by which they may be connected together, the whole being arranged substantially in manner and for the objects or purposes herein set forth.

Improvement in Corn-Shellers. By PIERSON READING, Batavia, Ohio. Sept. 25th.

CLAIM.—What I claim as my invention, and which I desire to secure by letters patent, is :—

1. The arrangement of the endless inclined feeding belt, with iron plates fixed thereto, in combination with the upward inclining hopper, and the revolving spur wheel turning in said hopper, for adjusting the ears, so as to cause them to approach the sheller endwise, and these in combination with the sheller B, and double springs c^1, c^2, for shelling several ears at the same time, and the endless open cob conveyer, as described.

2. The arrangement of the hinged shutter at the head of the inclined plane, for yielding to an accumulation of ears, so as to permit the endless conveyor F to work freely, as described.

3. The arrangement of the oblique teeth *b* on the face of the sheller B, for giving the ears a forward progressive movement, whilst the teeth *b* give them a rotary motion, and shell the corn, as described, in combination with the teeth *a*, as herein set forth.

Improvement in the construction of Beehives. By HIRAM A. PITTS, Winthrop, Me. Sept. 25th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the manner herein set forth of constructing the bottom or protector, the upper floor upon which the bees are to enter, consisting of frames with wire gauze stretched across them, and there being below this a second, and, if desired, a third floor, having spaces between them for the entrance of the bee moth, so prepared and furnished, in the manner described, as to induce the moth to deposit its eggs therein, and so arranged and connected with the hive as to be readily removed and replaced, substantially as herein made known.

Method of transporting Bales of Cotton to market by floating them in the form of Rafts. By GEORGE R. GRIFFITH, Mobile, Ala. Sept. 25th.

CLAIM.—What I claim therein as new, and desire to secure by letters patent, is the forming or constructing of rafts of bales of cotton, by combining said bales together in the manner herein set forth; that is to say, by first providing each separate bale with a case or envelop of water-proof cloth, made and attached thereto in the manner described, and attaching said bales to each other so as to form a narrow raft, con-

sisting of pairs of bales, by ropes running along the whole line, by the ropes crossing from bale to bale, as herein described, and the uniting of these rafts of pairs laterally, by means of ropes between the separate pairs of bales, to any required extent. And I do hereby declare, that I do not intend to confine or limit myself to the precise manner of attachment herein represented and made known, but to vary this as I may think proper, whilst I attain the same end by means substantially the same.

Improvement in the construction of Furnaces for Heating Air and Warming Apartments. By John A. Page, Boston, Mass. Sept. 25th.

Claim.—I shall claim the sliding button applied on the crank shaft, in combination with the projections above the button, the same being for the objects and purposes above specified.

Also, the mode of constructing the base, sustaining the fire-pot of the furnace, by making it in separate parts, supported on temporary walls or contrivances of a like character built inside of the main walls of the ash-pit, by means of which arrangement the fire-pot, or either of the plates, can be easily removed at any time, and others substituted, without disturbing the radiator or materially disarranging any of the adjacent parts.

I also claim the manner in which I have arranged the air-tubes of the radiator over the furnace, by placing their lower extremities around the edge of the fire-pot, and inclining them so that they shall converge towards each other at their upper ends, or where they enter the top plate of the radiator; also, combining said pipes, arranged with an exterior hollow, conical, frustum-shaped casing surrounding the same, by which mode of arranging the air-tubes and casing the fire is enabled to act more equally over their surfaces than in the arrangements now existing in which said tubes are placed perpendicularly over the furnace, and inclosed by a hollow cylinder, the whole being substantially as above described.

I also claim the partition, with its sliding valve and opening, combined with the radiator, and arranged in the rear of the same in front of the entrance of the smoke pipe, and extending upwards to within a short distance from the top of the radiator, its object being the retention of heat, all as described.

I also claim the method herein before above explained of constructing the lower or bottom plate of the radiator with a movable plate *dd*, Fig. 9, confined thereto by screws and nuts, by which arrangement a fire-pot of a different diameter can be easily substituted in the place of the one removed, by changing the movable plate for another having a circular aperture adapted to said fire-pot.

Improvement in Machines for cleaning and separating Garlic, &c. from Grain. By Joseph Heygel, Salisbury, Pa. Sept. 25th.

Claim.—What I claim as my invention, is the mode of forming the concave with a series of plates placed obliquely as at 1, 2, 3, in Fig. 3, provided with teeth placed in an inverse direction to those of the wings

of the boxes.—2d. The combination of four boxes more or less provided with winged wheels and teeth as above described, and with toothed plates in the above form and arrangement with an incline plane, so that the garlic shall successively be acted on thus: after receiving the action of box No. 1, the garlic that remains unbroken shall be subjected to the action of box No. 2; and that which remains unbroken from No. 2 shall be subjected to the action of No. 3; and that which remains unbroken from No. 3 shall be subjected to the action of No. 4.—3d. The combination of sieves B, C and L, and fan wheels F and D, with a series of boxes and cutters, in the manner above arranged.—4th. The combination of the cutters in box No. 1 with fan wheel F, and sieve L, to cut and throw out the hull of the garlic, thus enabling the remaining cutters to cut or break the grains thereof without obstruction.

Improvement in Machines for pressing or finishing Brick and Tile after the same have been Moulded. By Joseph B. Wilson, of Malden, and Alfred R. Crossman, of Huntingdon, Mass. Sept. 30th.

Claim.—We shall claim constructing the mould (independent of the followers) of separate pieces or plates of chilled cast-iron, hardened steel, or other suitable material, fitted to each other by shoulders, as described, and arranged in a frame and secured together by screws passing through the sides of the frame, the same being represented in Figs. 9, 10, 11, 12, or arranged and confined together by screw bolts as exhibited in Figs. 1, 2, 3, 4, and as herein before explained, the whole being for the purpose of contracting the mould in its length or width, and thus obviating at any time whenever necessary, and in manner above set forth, the difficulties resulting from the wear of the inner surface of the mould.

We also claim interposing a piece of cloth felting or other suitable material of like character, between the plates composing the back follower, in manner above described, the cloth being from time to time saturated with any unctuous or fatty matter, the whole being for the purpose of lubricating the interior of the mould as above set forth.

We also claim the machinery for producing the impression, and removing the brick from the mould, the same consisting of the eccentrics with their cams or wipers, as exhibited in Figs. 14 and 15, and constructed, arranged and operating together substantially in the manner as herein above explained.

Improvements in the Machine for Planing Boards, and Timber of other kinds. By Hervey Law, Wilmington, N. C. Sept. 30th.

Claim.—What I claim therein as new and as of my invention, and which I desire to secure by letters patent, is the manner herein set forth of planing boards, plank or other timber by means of reciprocating or vibrating plane stocks, operating upon stuff held by the iron gripers PP, and which stocks are to be moved back and forth to a short distance, say to that of a foot, more or less, and are to operate upon a corresponding length of the board or other timber to be planed, by means of a plane stock apparatus like that herein described.

And I also claim, in combination with such reciprocating plane

stocks, the manner of feeding the stuff to the planes, and of sustaining it against their action, by the combined operation of the gripers which are to seize and to draw the stuff back with the backward motion of the plane stock, and of the sliding bars or abutments which are made successively to pass in at the fore end of the stuff, and sustain it against the action of the cutting or plane irons. And I do hereby declare that I do not intend by the description herein given of the manner of forming and arranging the auxiliary parts of the apparatus, to limit or confine myself to the precise arrangements of these parts, but to vary them as I may find expedient, whilst the general construction and operation of the machine remain substantially the same with that herein set forth; and whilst it is made to retain those features by which it is distinguished from all other machines which have hitherto been constructed for the same purpose.

Machine for making Wire Heddles for the formation of Weavers' Harness. By Abraham Howe and Sidney S. Grannis, Morrisville, N.Y. Sept. 30th.

Claim.—Having thus fully described the nature of our machine for forming wire heddles, and explained the operation thereof, what we claim therein as new, and desire to secure by letters patent, is the manner in which we have combined and arranged the shafts P and Q, and their respective studs, with the arm N and its stud; the latter being made to revolve with the pinion M, the shafts and arm being made adjustable by an arrangement of parts substantially the same with that set forth, and for the purpose described.

We also claim the mounting of the above claimed apparatus upon a wheel revolving horizontally, the same being actuated substantially in the manner and used for the purpose above made known.

Improvement in the construction of the Wrought-iron Plough. By Joseph and Henry F. Cromwell, Cynthiana, Ky. Sept. 30th.

Claim.—What we claim as our invention, and which we desire to secure by letters patent, is the method of combining the mould-board point and land side or bar of the plough, as herein set forth, viz. by constructing the land side and point in one piece, detached from the mould-board, and attaching the latter to it by means of a groove in the point and ears, riveted on the land side, through which bolts are passed, so as to secure the whole.

Machine for sticking Pins into Papers. By Samuel Slocum, Poughkeepsie, N. Y. Sept. 30th.

Claim.—What I claim as my invention, and desire to secure by letters patent, is:—

1. The plate with grooves for receiving the pins.

2. The sliding hopper which deposits the pins in the grooves, as described.

3. The sliding plate or follower, with the wires attached thereto, in combination with the groove plate as described, and also these in combination with the hopper, as described.

Improvement on his Combination Door Lock, patented January 11, 1836. By Solomon Andrews, Perth Amboy, N. J. Sept. 30th.

Claim.—What I claim therein, and desire to secure by letters patent, is the combining of the upright or vertical tumblers C, with the horizontal tumblers AA, in such manner as that the latter shall be lifted by the former instead of by the bits of the key; the said upright tumblers C being so formed as to have their inferior curves or belly to coincide with each other in the manner set forth, when not acted upon by the bits of the key, or in any other manner which is substantially the same in combination and action, and which will give a false impression as regards the various lengths of the several key bits which act upon them, when this is attempted to be ascertained through the keyhole.

I claim the forming of the second belly or concavity E, in each of the upright tumblers and in any form of tumbler; said concavity being so situated as to receive the respective bits of the key at the instant the bolt stump is to enter the openings in the ends of the tumblers, and thus suspending the action of said bits during the time of the moving of the bolt, in the manner set forth.

Improvement in the machine for making Crackers. By Riley Darling, East Greenwich, R. I. Sept. 30th.

Claim.—I do not claim as of my invention, the construction of the parts for rolling the dough and cutting the crackers, nor do I claim simply the combination of the two; but what I do claim as my invention, and desire to secure by letters patent, is the manner herein described of combining the operation of the two by means of the double crank in combination with the connecting rod J, and pendulous lever *h* attached to the cutting part, and the hands I, and ratchet wheel K, attached to the rolling part, all as herein described.

LIST OF ENGLISH PATENTS

GRANTED BETWEEN THE 22D OF SEPT. AND THE 24TH OF OCTOBER, 1841.

Jean Louis Alphonse Petigars, of Brewer-street, Golden-square, gentleman, for improvements in the construction of presses. Sept. 24; six months. (Being a communication.)

Hugh Lee Pattinson, of Bensham Grove, Gateshead, manufacturing chemist, for improvements in the manufacture of white lead, part of which improvements are applicable to the manufacture of magnesia and its salts. Sept. 24; six months.

Frederick Brown, of Luton, Bedford, ironmonger, for improvements in stoves or fire-places Sept. 24; six months.

Theodore Frederick Strong, of Goswell-road, engineer, for certain improvements in locks and latches. Sept. 28; six months.

Samuel Stocker, of Barford-street, Islington, engineer, and George Stocker, of Birmingham, cockfounder, for improvements in machinery and apparatus for raising, forcing, conveying and drawing off liquids. Sept. 28; six months.

John While, of Burton, in the Wolds, Leicester, tanner, for an improved horse-hoe, for use in agricultural pursuits. Sept. 29; four months.

Joseph Miller, of Monastery Cottage, East India Road, engineer, for an improved arrangement and combination of certain parts of steam-engines used for steam navigation. Sept. 29; six months.

Edward Welch, of Liverpool, architect, for certain improvements in the construction of bricks. Sept. 30; six months.

William Hirst and Joseph Weight, of Leeds, clothiers, for certain improvements in the machinery for manufacturing woolen cloth, and cloth made from wool and other materials. Oct. 7; six months.

Thomas Wells Ingram, of Birmingham, manufacturer, for improvements in shears and other apparatus for cutting, cropping, and shearing certain substances, parts of which said invention being a communication from a foreigner residing abroad. Oct. 7; six months.

Joseph Clisild Daniell, of Tiverton Mills, Bath, for improvements in the manufacture of manure, or a composition to be used on land as a manure. Oct. 7; six months.

Mathias Nicholas La Roche Barre, of St. Martin's Lane, Middlesex, manufacturer of cotton, for an improvement in the manufacture of a fabric applicable to sails and other purposes. Oct. 7; six months.

Marcus Davis, of New Bond-street, optician, for improvements in the means of ascertaining the distances vehicles travel. Oct. 7; six months.

Thomas Biggs, of Leicester, merchant, for improvements in securing hats, caps, and bonnets from being lost by the effect of wind or other causes. October 7; six months.

Benjamin Anigworth, of Birmingham, gentleman, for improvements in the manufacture of buttons. Oct. 7; six months.

John Jones, of Smethwick, Birmingham, engineer, for certain improvements in steam-engines, and in the modes or methods of obtaining power from the use of steam. Oct. 7; six months.

John Harwood, of Great Portland-street, gentleman, for an improved means of giving expansion to the chest. Oct. 7; six months.

William Newton, of Chancery-lane, civil engineer, for certain improvements in engines to be worked by gas, vapor or steam. (Being a communication.) Oct. 14; six months.

Moses Poole, of Lincoln's Inn, gentleman, for improvements in firearms. (Being a communication.) Oct. 14; six months.

Edward Massey, of King-street, Clerkenwell, watchmaker, for improvements in watches. Oct. 14; six months.

Henry Ross, of Leicester, worsted manufacturer, for improvements in combing and drawing wool, and certain description of hair. Oct. 15; six months.

Junius Smith, of Fen-court, Fenchurch-street, gentleman, for improvements in machinery for manufacturing cloths of wool and other fibrous substances. (Being a communication.) Oct. 20; six months.

John Bradford Furnival, of Street Ashton, farmer, for improvements in evaporating fluids, applicable to the manufacture of salt, and to other purposes where evaporation of fluids is required. Oct. 20; six months.

Henry Davies, of Birmingham, engineer, for certain improved tools or apparatus for cutting or shaping metals and other substances. Oct. 21; six months.

Thomas Jones, of Varteg Forge, near Pontypool, Monmouth, engineer, for improvements in the construction and arrangement of certain parts of marine and stationary steam-engines. Oct. 21; six months.

James Whitworth, of Bury, Lancaster, manufacturer, and Hugh Booth, of the same place, machine maker, for certain improvements in looms for weaving. Oct. 21; six months.

Martin John Roberts, of Brynycaeran, Carmarthen, gentleman, and William Brown, of Glasgow, merchant, for improvements in the process of dyeing various matters, whether the raw material of wool, silk, flax, hemp, cotton, or other similar fibrous substances, or the same substances in any stage of manufacture, and in the preparation of pigments or painters' colors. Oct. 26; six months.

Thomas Holcroft, of Nassau-street, Middlesex, gentleman, for an improved portable safety boat or pontoon. Oct. 20; six months.

LIST OF PATENTS GRANTED FOR SCOTLAND FROM THE 22D OF AUGUST TO THE 22D OF OCTOBER, 1841.

William Lewis Rham, of Winkfield, Berks, clerk, for certain improvements in machinery or apparatus for preparing land, and sowing or depositing grain, seeds, and manure. August 23.

Nathan Waddington, of Hulme, Lancaster, engineer, for certain improvements in the construction of boilers and boiler furnaces. August 25.

John Cox, of Gorgie Mills, Edinburgh, tanner and glue manufacturer, for improvements in apparatus for assisting or enabling persons to swim or float and progress in water. August 25.

James Sidebottom, of Waterside, Glossop, Derby, manufacturer, for certain improvements in machinery or apparatus for preparing cotton and other fibrous substances for spinning. August 30.

Francis William Gerish, of East Road, City Road, Middlesex, patent hinge-maker, for improvements in locks and keys, and other fastenings for doors, drawers, and other such purposes. Sept. 2.

Samuel Hardham, of Farnworth, near Bolton, Lancaster, spindle and fly maker, for certain improvements in machinery or apparatus for roving and slubbing cotton and other fibrous substances. Sept. 3.

Louis Lachenal, of Titchfield-street, Soho, mechanic, and Antoine Vieyres, of No. 40 Pall-mall, watchmaker, both in the county of Middlesex, for improvements in machinery for cutting cork. Sept. 7.

Joshua Taylor Beale, of East Greenwich, Kent, engineer, and Benjamin Beale of the same place, engineer, for certain improvements in steam-engines. Sept. 8.

Charles Sneath, of Nottingham, lace manufacturer, for certain improvements in machinery for the making or manufacturing of stockings or other kinds of loop-work. Sept. 13.

Lawrence Kortwright, of Oak Hall, East Ham, Essex, esquire, for certain improvements in treating and preparing the substance commonly called whalebone, and the fins and such like other parts of whales, and rendering the same fit for various commercial and useful purposes. (Being a communication from abroad.) Sept. 14.

William Newton, 66 Chancery-lane, Middlesex, civil engineer, for certain improvements in machinery for making pins and pin nails. (Being a communication from abroad.) Sept. 15.

Thomas Craddock, of Broadheath, Radnor, farmer, for certain improvements in steam-engines and boilers. Sept. 16.

William Newton, 66 Chancery Lane, Middlesex, civil engineer, for certain improvements in looms for weaving. (Being a communication from abroad.) Sept. 17.

William Scamp, of No. 11, Upper Charlton Terrace, near Woolwich, Kent, surveyor, for an application of machinery to steam vessels for the removal of sand, mud, soil, and other matters from the sea, rivers, docks, harbors, and other bodies of water. Sept. 21.

Thomas William Berger, of Upper Homerton, Hackney, Middlesex, gentleman, for improvements in the manufacture of starch. Sept. 22.

Thomas Gore, of Manchester, machine maker, for certain improvements in machinery or apparatus for roving, spinning and doubling cotton, silk, wool, and other fibrous materials. Sept. 24.

Thomas Warren, of Montague Terrace, Mile End Road, Middlesex, gentleman, for an improved machine for making screws. Sept. 30.

George England, of Westbury, Wilts, clothier, for improvements in weaving woolens and other fabrics, and for twisting, spooling and warping woolen and other fabrics; also for improvements in the manufacture of woolen doe-skins. Sept. 30.

William Church, of Birmingham, gentleman, for certain improvements in hooks and eyes, and in machinery for manufacturing the same. Oct. 4.

Joseph Miller, of Monastery Cottage, East India Road, Middlesex, engineer, for an improved arrangement and combination of certain parts of steam-engines used for steam navigation. Oct. 8.

John Varley, of No. 3 Bayswater Terrace, Bayswater, artist, for an improvement in carriages. Oct. 11.

John Barwise, of St. Martin's Lane, chronometer maker, and Alexander Bain, of Wigmore-street, mechanist, for improvements in the application of moving power to clocks and time-pieces. Oct. 15.

William Craig, engineer, Robert Jarvie, rope-maker, and James Jarvie, rope-maker, all of Glasgow, for certain improvements in machinery for preparing and spinning hemp, flax, wool, and other fibrous materials. Oct. 19.

William Edward Newton, 66 Chancery Lane, civil engineer, for certain improvements in the manufacture of fuel. (Being a communication from abroad.) Oct. 19.

Floride Heindruckx, of Fenchurch-street, London, engineer, for certain improvements in the construction and arrangement of fire-places and furnaces, applicable to various useful purposes.

INDEX TO VOL. IV.